

# Bulletin of the International Railway Congress Association

## CONTENTS OF THE NUMBER FOR DECEMBER 1953.

725 .3

Bull. of the Int. Ry. Congress Ass., No. 12, December,  
p. 935.

BOGARIM (José, Chedas). — Modernisation of station buildings and methods employed in financing modernisation projects. Standardisation of unit construction applied to railway buildings. (Question 2, 16th. Congress.) Report (*Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia*) (6 000 words.)

1953 385 .4

Bull. of the Int. Ry. Congress Ass., No. 12, December,  
p. 949.

DUGAS (R.). — Determination of the principles of geographical and functional organisation of a railway system. Simplification and retrenchment of the administration of railways. (Question 8, 16th Congress.) Report (*Austria, Belgium and Colony, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia*) (16 000 words & tables.)

1953 385 .57

Bull. of the Int. Ry. Congress Ass., No 12, December,  
p. 985.

LEMASS (F.) — Modernisation of the methods to be adopted for recruiting the staff in number and qualification. Harmonious renewal of the various ranks, indispensable reserve lists, ratio of the permanent and temporary staff. Part played by the medical service in the recruiting. (Question 7, 16th. Congress.) Supplement to Report (4 000 words.).

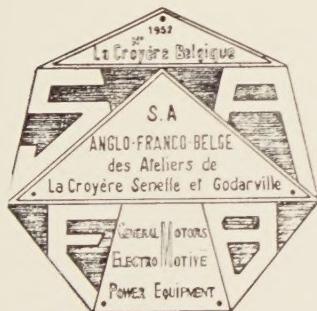
1953 625 .17

Bull. of the Int. Ry. Congress Ass., No 12, December,  
p. 993.

FEYRABEND (C.). — What are the present tendencies relating to the organization of the maintenance of the permanent way: methods of determination of the works to be done and in particular, possibilities of the use of detecting-recording coaches; planning of the works, effects of mechanization; importance of the side-tracks for the movement of the gangs and the mechanical devices. Economic and financial aspect. (Question 1, 16th Congress.) Report (*Belgium and Colony, France and French Union, Greece, Italy, Luxemburg, Netherlands, Portugal and Colonies, Spain, Switzerland, Syria and Turkey*) (26 000 words, tables & figs.).



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# Alphabetical Index of Advertisers

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—	Transport and Communications.
—	Locomotive injectors.
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—	Boiler feedwater treatment.
—	Axleboxes.
—	Machine-tools.
—	Permanent way equipment.
—	Fluorescent lamps for railway coaches.
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—	Railway plant.
—	Axleboxes.
V	Automatic slack adjusters.
—	Rails, sleepers.
—	Axleboxes.
—	Railway equipment.
—	Superheaters for locomotives.
—	Decoration for the interior of Railway carriages.
IV	Railway materials.
—	Automatic couplers; steel castings for railway rolling stock.
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—	Hydrophilous emulsion for external cleaning of railway carriages.
—	Locomotives.
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—	Fireboxes for locomotives.

**MONTHLY BULLETIN**  
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CONTENTS OF THE NUMBER FOR DECEMBER 1953.

CONTENTS	Page.
I. Modernisation of station buildings and methods employed in financing modernisation projects. Standardisation of unit construction applied to railway buildings (Question 2, 16th Congress.) Report ( <i>Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia</i> ), by José Chedas BOGARIM . . . . .	935
II. Determination of the principles of geographical and functional organisation of a railway system. Simplification and retrenchment of the administration of railways. (Question 8, 16th Congress.) Report ( <i>Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia</i> ), by R. DUGAS . . . . .	949
III. Modernisation of the methods to be adopted for recruiting the staff in number and qualification. Harmonious renewal of the various ranks, indispensable reserve lists, ratio of the permanent and temporary staff. Part played by the medical service in the recruiting. (Question 7, 16th Congress.), Supplement to the Report by F. LEMASS . . . . .	985

CONTENTS ( <i>continued</i> ). <hr/>	Page.
IV. What are the present tendencies relating to the organization of the maintenance of the permanent way : methods of determination of the works to be done and in particular, possibilities of the use of detecting-recording coaches; planning of the works, effects of mechanization; importance of the side-tracks for the movement of the gangs and the mechanical devices. Economic and financial aspect. (Question 1, 16th Congress). Report ( <i>Belgium and Colony, France and French Union, Greece, Italy, Luxemburg, Netherlands, Portugal and Colonies, Spain, Switzerland, Syria and Turkey</i> ), by C. FEYRABEND . . . . .	993
V. ANALYTICAL TABLE OF ARTICLES ACCORDING TO THE DECIMAL CLASSIFICATION . . . . .	1 to 8
VI. CONTENTS OF THE 30TH YEAR OF THE ENGLISH EDITION . . . . .	I to VII

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**Permanent Commission of the International Railway Congress Association**

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An edition in French is also published.

BULLETIN  
OF THE  
**INTERNATIONAL RAILWAY CONGRESS**  
ASSOCIATION  
(ENGLISH EDITION)

[ 725 .3 ]

**INTERNATIONAL RAILWAY CONGRESS ASSOCIATION**

16th. SESSION (LONDON, 1954).

**QUESTION 2.**

**Modernisation of station buildings and methods employed in financing modernisation projects.  
Standardisation of unit construction applied to railway buildings.**

**REPORT**

(*Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia*),

by JOSÉ CHEDAS BOGARIM,

Ingénieur en Chef de la Division du Matériel de la Direction Générale des Transports Terrestres de l'État Portugais.

**FOREWORD.**

The questionnaire on which this report is based was sent to 66 Administrations; 37 replies were received, but only 15 who replied to the whole of the questionnaire or part of it, gave any useful or interesting information.

Amongst this group of 15 Railways, complete or detailed replies were received from the following Administrations :

**GERMANY** : German Federal Railways : D.B.

**BELGIUM & COLONY** : Belgian National Railways Company : S.N.C.B.

**SPAIN** : Spanish National Railways : R.E. N.F.E.

**FRANCE** : French National Railways Company : S.N.C.F.

**GREECE** : Greek Railways : C.F.E.H.

**ITALY** : Italian State Railways : F.S.

**HOLLAND** : Netherlands Railways : N.S.

**PORTUGAL & COLONIES** : Portuguese Railways Company : C.P.

**SWITZERLAND** : Swiss Federal Railways : C.F.F.

The following Administrations did not reply completely to the questionnaire or merely supplied simple information :

**AUSTRIA** : Austrian Federal Railways : Ö.B.B.

**FRANCE & FRENCH UNION** : French Light Railways : C.G.F.L.

GAFSA Railway : C.F.G.

Tunisian Railways : C.F.T.

**ITALY** : North of Milan Railway : F.N.M.

**LUXEMBURG** : Luxemburg National Railways Company : S.N.C.F.L.

The *Bernese Alps Railway* asked us to refer to the replies received from the Swiss Federal Railways which they consider apply equally to their system where operating conditions are identical.

A. — Modernisation of station buildings and methods employed in financing modernisation projects.

1. — *Are proposals for modernisation of station buildings accompanied by financial and statistical details showing the anticipated traffic and net revenue from the proposals?*

The following Administrations : *D.B.*, *Ö.B.B.*, *R.E.N.F.E.*, *S.N.C.F.*, *C.F.T.*, *C.F.E.H.*, and *C.F.F.* replied on similar lines, stating that the proposals to modernise stations are generally accompanied by financial and statistical studies to enable their cost to be compared with the economic advantages resulting from their achievement.

The *Austrian Federal Railways* (*Ö.B.B.*) stated in their reply that station buildings are generally divided into :

*a)* buildings used for the Traffic Department;

*b)* buildings used for the auxiliary services, intended for the convenience of passengers.

The estimate of the amount of space needed by the Traffic Department (*a*) is based on statistical studies of the number of trains, number of tickets sold, etc.; the net revenue is not taken into consideration.

The estimate for the auxiliary installations (*b*) is based on a detailed study of the revenue expected from the traffic.

The *Tunisian Railways* replied that the modernisation of the stations on its system was achieved with their reconstruction after the war, but should such modernisation become necessary for traffic reasons, it would be accompanied by financial and statistical studies.

The *S.N.C.B.*, *F.S.*, *North of Milan*, *Luxemburg*, *Netherlands* and *Portuguese Railways* replied in the negative to this question, considering that in general there was no need for such studies.

The *S.N.C.B.* told us that in most cases, modernisation of the stations on their system is necessary not on account of the traffic, but to facilitate and improve the passenger services.

Financial and statistical studies are therefore not required unless it is a question of completely new buildings.

The *F.S.* state that as they are a State undertaking, the modernisation of the stations is not tied down with financial plans but only concerned with the higher receipts obtainable from carrying out such work.

The principles commonly followed from this point of view whilst leaving aside considerations of a strictly economic character, are as follows :

*a)* importance of the locality where the station is built from the tourist, historical, artistic, industrial and commercial points of view;

*b)* numerical importance of the passenger and goods service;:

*c)* condition of the existing installations.

On the *Gafsa Railway* modernisation proposals are sometimes accompanied by financial and statistical studies, but there is not much work of this kind to be done.

2. — *Is capital expenditure on modernisation of station buildings related exclusively or mainly to the net revenue from traffic originating and/or terminating at such station?*

Most of the Administrations replied that the capital cost of modernising their stations does not depend exclusively or chiefly on the net revenue from the traffic of these stations. The following Administrations replied in this way : *D.B.*, *Ö.B.B.*, *S.N.C.B.*, *S.N.C.F.*, *Gafsa Railway*, *F.S.*, *Luxemburg* and *Netherlands Railways*, and *Portuguese Railways*.

The Austrian Federal Railways stated that the costs in question depend primarily upon the operating requirements.

The S.N.C.B. replied : « No, not exclusively, for the reasons given under 1; but naturally more will be done to modernise the large stations than station with less traffic. »

The S.N.C.F. states that the modernisation of stations is not necessarily directly linked to the receipts relating to the traffic coming from or at destination of the stations.

The F.S. do not make the cost of modernising stations depend exclusively or principally on the net revenue which can be expected from them, and only take into account indirectly the financial benefits to be expected for the Administration from carrying out modernisations and improvements.

The Luxemburg and Portuguese Railways replied in the negative, without giving any details.

The Gafsa and Netherlands Railways also replied in the negative, but the first of these Administrations is of the opinion that the said costs depend above all on the operating economies to be expected as a result of modernisation, and the second that they depend, in general, on the importance of the traffic as a whole (including traffic in transit).

The Greek and Tunisian Railways replied in the affirmative, the former being of the opinion that the costs in question should chiefly depend on the revenue from local traffic.

The C.F.F. and North of Milan Railways gave identical replies, stating that the said costs depend to some extent on the revenue from traffic to or from the modernised stations.

3. — a) *Is it the practice to take into consideration earnings in the form of rents and/or percentages of profits — from ancillary services, such as :—*

*shops and kiosks;  
restaurants and hotels;  
cloakrooms and hairdressing establishments;  
day hostels;  
show cases and commercial advertising.*

b) *Do tenants make direct contributions to the capital cost or indirect contributions through the rent charged or the percentages of profit retained ?*

Part a). — The following Administrations replied in the affirmative : S.N.C.B., R.E.N.F.E., North of Milan and the French Light Railways (C.G.F.L.).

The R.E.N.F.E. limits its affirmative to important stations and the French Light Railways (C.G.F.L.) to kiosks and commercial advertising.

The Greek Railways, though they did not reply to this part of the question, must be included in this group in view of their reply to points 1 and 2 above.

The following Administrations replied in the negative to this part of question 3 : Luxemburg, Netherlands, Portuguese and Swiss Federal Railways.

In addition, the C.F.F. point out in their reply that the profits from the auxiliary services are not kept apart. The rents and the percentage of the gross receipts are included in the general accounts of the CFF, but they are taken into account in calculating the profitability of the investments in question.

On the Gafsa and Tunisian Railways the receipts from these auxiliary services are negligible. They are not taken into account in the financial investigations in question.

The S.N.C.F. and F.S. did not give any precise answers to this part of the questionnaire. It appears from their replies to questions 1 and 2, that these Administrations do not make it a practice to take the profits from the auxiliary services into account for this purpose.

The *Ö.B.B.* and *D.B.* did not supply any information relative to this part of the question.

*Part b).* — On the *R.E.N.F.E.*, *Greek* and *Moroccan Railways* the lessees make an indirect contribution to the capital costs by their rents.

On the *F.S.*, the concession-holders of auxiliary services also make an indirect contribution to the improvements to the buildings in the form of a suitable increase in their rents. In some cases, the Administration may carry out work at the expense of the actual concession-holder, who gets back his capital in the form of reduced rents over a certain number of years.

A similar form of direct contribution is used by the German Railways (*D.B.*). The concession-holders of the auxiliary services pay a rent. Formerly, they had to stand the cost of reconstruction or modernisation of the buildings in question as far as possible, by placing credits at the disposal of the Administration for this purpose, repayable by total or part refunds of a certain number of rentals.

The respective interest is either wholly or in part borne by the lessee. The present tendency is gradually to do away with this contribution from the concession-holder; the Administration endeavouring to find the capital required for modernisation or reconstruction itself.

On the *N.S.*, in some cases, the lessees make a direct contribution to the capital costs, but the general rule is for them to pay a rent or some percentage of their receipts.

On the *Ö.B.B.* and *C.F.F.*, the lessees pay an indirect contribution to the capital costs in the form of a percentage of their receipts, but on the *Austrian Railways*, they also make a direct contribution by supplying the necessary equipment (for example, tables, chairs, etc.).

On the *S.N.C.B.*, the lessees of the auxiliary services pay a rent, and the cost of interior decorations and arrangements are in principle at their charge.

In the case of buffets and bars, a percentage of the receipts may be set aside for the improvement of the premises.

On the *S.N.C.F.* the cost of fitting out display windows, kiosks and shops is usually borne by the lessees.

The concession-holders of buffets and hotels pay a rent proportional to the receipts. In principle, the cost of fitting out the building is borne by the *S.N.C.F.*, whilst the cost of the moveable equipment is borne by the concession-holder.

Exceptionally in a few particular cases the lessees of buffets have shared in the cost of modernising them.

The *Portuguese Railways* replied in the negative to this part of question 3.

The *Gafsa Railway* have had lessees share in the capital costs as far as possible (direct contributions).

On the *Luxemburg Railways* the costs are borne by the lessee.

4. — *In assessing the anticipated net revenue from the reconstruction is the additional equated annual maintenance and renewal liability assessed on :—*

- a) *a uniform percentage basis applied to the capital expenditure on the modernisation of the station and to the cost of replacing the displaced assets respectively, or*
- b) *are differential percentages applied in order to reflect the different forms of construction and expectation of life ?*

The replies received from the *D.B.*, *S.N.C.F.*, *Gafsa*, *North of Milan* and *Portuguese Railways* were negative; they do not make any calculations of the kind covered by this question.

The *Greek Railways* apply formula a).

The *N.S.* and *C.F.F.* use differential percentages according to b).

The *Ö.B.B.* apply the differential percentages b) for brickbuilt buildings, interior

decoration and fittings but only in the case of the auxiliary services.

The *R.E.N.F.E.* has used both formula *a*) and formula *b*).

The reply received from the *S.N.C.B.* and *F.S.* was not sufficiently precise to enable us to affirm that these Administrations apply formula *a*) or *b*) in certain cases.

The *S.N.C.B.* reported that owing to the lack of sufficiently precise data and in order to simplify matters, the maintenance and renewal costs are taken as a percentage of the cost of reconstruction, although it is obvious that certain more exposed portions will require higher maintenance and renewal costs.

The *F.S.* replied on similar lines, but the percentage varies according to the type of building, the intrinsic nature of the materials used, the use for which the buildings are intended and the date at which they were erected.

The other Administrations did not supply any information.

*5. — What steps are taken, in the planning stage of a reconstruction project, to ensure that administrative economies arising from improved methods of working, mechanisation, etc. are considered with a view to achieving economies in building?*

The Administrations consulted gave the following information :

*Deutsche Bundesbahn.* — In order to make sure that improved working methods will be adopted for the proposed work, certain regulations and standards have been laid down in order to obtain the most suitable layouts, enabling economies in construction to be obtained whilst respecting modern methods of working (mechanisation, etc.). These regulations and standards will be progressively added to.

The *Ö.B.B.*, *S.N.C.B.*, *Greek*, *Portuguese* and *F.S.* Railways gave replies which may be considered identical in essence.

On these Administrations, it is reported

that the intervention and collaboration of the different departments whilst the proposals are being drawn up and even whilst the work is being carried out gives an assurance that the buildings will meet the ultimate requirements of all departments and that economies will be obtained by improved working methods, both as regards the building and future operating costs.

The *S.N.C.F.* point out that during the elaboration of the proposals, care is taken to design buildings which will make operating economies possible by enabling the working methods to be improved (mechanisation, regrouping of the departments for example) as well as making savings during the actual building.

On the *N.S.*, whilst the scheme is being prepared, account is taken of modern methods of working, the possibilities of mechanisation, etc., in order to make every possible economy.

On the *C.F.F.* rational organisation is taken into account when siting the buildings and places of work.

On the *R.E.N.F.E.*, all necessary steps are taken to make sure the economies allowed for in the preliminary reconstruction studies are actually obtained.

The *Gafsa Railway* makes as detailed as possible a plan of reconstruction in order to obtain every possible economy when the building starts.

The other Administrations did not supply any useful information.

*6. — How is provision made for the long-term capital expenditure involved in the reconstruction in stages, and over many years of very large stations?*

The following Administrations replied as follows :

*D.B.* — At the present time there are no long term investments in Germany.

Owing to the difficulty of obtaining credit, reconstruction work has to be carried out in phases, spread over several years, and carried out in such a way that the

buildings completed with the funds available can be used as soon as they are finished.

*F.S.* — The same methods as formerly are still followed in the case of important work involving considerable capital expenditure which the Administration cannot afford in a lump sum. The work is divided up into several phases as on the Deutsche Bundesbahn.

In selecting what work shall be done in each successive phase, priority is given as far as possible to that which directly affects the operating; in addition care is taken as far as possible to avoid building installations having a temporary character on account of this splitting up of the work into stages.

It appears from this reply, that the cost of building is included in the normal annual budget.

*Ö.B.B., N.S., and C.F.F.* — The cost of buildings which have to be spread over several years have to be met out of the budget for each year.

*S.N.C.B.* — The reconstruction of important stations affects several budgets. Reconstruction actually speaking, if due to war damage, is financed by the State; if necessitated by the age of the buildings, is a renewal cost charged up to the operating receipts. The same applies in the case of small alterations and improvements. New work involving extensions or considerable increase in value is taken as a capital charge to be covered by a loan.

*S.N.C.F.* — In the case of capital work of some importance, 20% of the cost is borne by the Company and charged to the operating costs. As regards the balance, the S.N.C.F. makes use either of a loan from the State (modernisation and equipment funds) or long term loans authorised and guaranteed by the State from private investors or the banks.

To date no outside capital has been called upon for work on stations which

moreover is generally carried out in phases which are relatively quickly completed and usable as soon as finished.

*R.E.N.F.E.* — Reconstruction work is carried out in agreement with the measures laid down in the General Reconstruction Plan.

The other Administrations did not supply any useful information, or stated the case did not arise.

7. — *What formulae are used in the allocation of expenditure on modernisation between capital and revenue accounts?*

The *D.B.*, *I.S.*, *C.I.T.*, and *Gafsa Railways* gave similar replies.

Costs relating to new installations, including the replacement of complete installations, and increasing the capacity of existing installations are charged to the capital account. Modernisation costs which also include maintenance or renewal work are charged to the operating account when such work does not constitute a real improvement, an increase in potential or an increase in the capacity of the installations.

On the *N.S.*, modernisation costs are generally charged to the capital account. On the *Tunisian Railways* special credits are always allowed for this type of work.

On the *S.N.C.B.*, the costs involved in modernisation work are divided up amongst the different accounts, according to the principles reported under question 6.

On the *S.N.C.F.*, modernisation costs up to 5 millions francs are charged to the operating account. Larger sums are charged to the capital account, with a deduction of the portion found by the company itself, as stated in Question A-6.

The *R.E.N.F.E.* and *Portuguese Railways* have not made use of any particular formula, and the *Austrian Railways* do not divide up the costs between capital and operating accounts.

8. — *To what extent and on what basis have outside bodies, such as local authorities, contributed towards the cost of reconstruction projects?*

From the replies received from the following Administrations : *S.N.C.B., R.E.N.F.E., S.N.C.F., F.S., N.S. Tunisian, Moroccan and Luxemburg Railways*, we can conclude that there are no special rules about this.

In general, when other undertakings wish to make larger or more luxurious installations than actually required for operating needs, they have to support the additional cost.

Such contributions are decided upon in each case by agreement between the railway and the other undertakings, in accordance with the nature and characteristics of the work.

The *S.N.C.F.* report that in order to hurry up the reconstruction of stations destroyed during the war, certain communities have advanced the capital sums required for such reconstruction.

The *S.N.C.F.* will repay such advances by means of the credits allocated to them for reconstruction, so that the charge will be wiped out in due course.

The *S.N.C.B.* state that the amount of the contribution is generally between 20 and 50 %, but it may happen that the State takes over the whole cost.

On the *R.E.N.F.E.*, the contribution may consist of capital, materials or labour, according to the case.

The *D.B.* and *Ö.B.B.* replied that other undertakings do not contribute to the financing of station reconstruction programmes.

The *Greek Railways* replied in the negative. On the *Portuguese Railways* there have been very few such contributions from the local authorities.

\* \* \*

A. — *Summary of the replies received from the Railway Administrations.*

1. — A group of Administrations, operating important systems of lines, accompany their proposals of modernisation of stations by financial and statistical studies as covered by this question, and consider such studies to be justifiable or essential in order to judge of the value of modernisation from the economic advantages expected therefrom.

Another group, though of less importance in view of the smaller size of their systems, do not carry out such studies because they do not consider them necessary, although generally speaking modernisation is necessitated by traffic requirements which have to be taken into account.

From the replies received, it appears that modernisation, which has been carried out at many stations in recent years, has only covered those damaged or destroyed during the war.

2. — On most Railway Administrations, the capital costs involved in the modernisation of stations does not depend exclusively or principally on the net revenue from the traffic attributable thereto.

In general, they are a function of the operating requirements.

3. — *First part.* — The number of Administrations who in investigations into the modernisation of stations take into consideration the profit due to the auxiliary services, is rather less than the number of those who gave a negative reply to this question. Consequently, it is not possible to lay down any general tendency in this connection.

3. — *Second part.* — As regards the contribution towards the capital investment required for modernisation, this is collected indirectly in the form of rent or a percentage of the receipts. The latter is the less frequent practice.

4. — In view of the diversity of the replies received, it is not possible to give the

general preference as regards the choice of the formulae given in the question.

Certain Administrations do not make any calculations of this sort.

Those who prefer formula *a*) are equal in number to those who prefer formula *b*). Only one Administration makes use of both formulae.

5. — From the replies received from the different Administrations it appears that, in general, reconstruction plans for buildings are drawn up with the help and collaboration of the departments concerned in order to obtain installations which will allow of economies in the future as regards operating costs, and will meet all the service requirements.

Together with the elaboration of the plans, an investigation is carried out into the methods of work to be applied, in order to obtain economies in construction.

6. — Long term reconstruction work on important stations spread over several years is usually financed from the operating receipts.

On the S.N.C.F., only 20 % of the costs are included in the operating costs; the remainder is financed by State loans or by long term loans authorised and guaranteed by the State.

The German Railways also have recourse to special credits, which are also used by the S.N.C.B., for new work which is considered to be a capital investment.

Generally, reconstruction work necessitated by war damage is financed by the State.

7. — As a general rule, it can be stated that in the case of modernisation programmes, the costs are divided up as follows :

all the costs of new installations or any enlargement, technical improvement or increase in capacity of existing installations are included in the capital account;

all costs due to maintenance work or renewal apart from the previous cases are included in the operating account.

8. — The financing of reconstruction programmes by other undertakings is a matter of agreement in each case. The contributions are generally based on the principle that the costs involved in work of interest to the railway are borne by the Railway Administration. Costs involved in having larger or more luxurious installations than operating requirements necessitates, or work decided upon for town planning or aesthetic reasons are borne by the other undertakings concerned.

This contribution may be based upon a percentage of the expenditure involved, varying according to circumstances, or be a long term loan.

\* \* \*

B. — Standardisation of unit construction applied to railway buildings.

1. — What system of standardised unit construction has been adopted, if any?

- a) Is the system based on a module or planning grid?
- b) Have good results been achieved in the provision of :  
thermal insulation;  
insulation against damp;  
sound insulation.
- c) Has the system been so developed that the erection of buildings can be undertaken by the railway's own labour?
- d) Has there been a problem of storage of component parts, their transport to building sites, and the supply of spares?

From the replies received from the Administrations it appears that standardisation is most frequently used by the S.N.C.F., S.N.C.B. and Greek Railways.

The S.N.C.F. has used standard plans for current constructions, such as locomotive roundhouses, service buildings and even the passenger buildings of small stations. These plans are actually most often guides which the building department has to adapt to

the various conditions of the site and locality.

The S.N.C.F. has, in addition, standardised certain simple units of construction such as: sills, doors, windows, roofing components, etc. as well as shower compartments, W.C.s, etc.

On the S.N.C.B., the method has been carried as far as local circumstances make possible, and has been applied to different types of buildings, in particular locomotive sheds.

The Greek Railways have applied standardisation of a type of construction to passenger buildings, goods depots, pointsmen's cabins, W.C., etc.

On the Gafsa Railway, the use of standard types of building is limited to such simple buildings as small stations and houses for keepers along the permanent way.

The F.S. formerly had a standardised type of construction for station and permanent way buildings; but this has now been given up almost completely because it was not suitable for the definitely artistic character of most Italian cities, even the smallest, which require a special solution in each case to harmonise with the architecture of the place in question.

The very great diversity of climate, countryside and customs are other important factors which militate against standardisation of buildings.

Only buildings having a definitely industrial character are standardised to some extent, such as goods depots, locomotive sheds and permanent way buildings, according to the very numerous types used in the different regions according to special local requirements.

Prefabricated buildings are only used to a very small extent, being limited to points-men's cabins, staff shelters, tool sheds, etc.

The Portuguese Railways have made a very limited use of this system, but not for passenger buildings.

The R.E.N.F.E., C.F.F. and N.S. have not

gone in for the standardisation of buildings, but only of certain building components or small constructions. Thus, the R.E.N.F.E. apply the method to roofings, the C.F.F. have limited standardisation to the booking office fittings and installations, and the N.S. to certain current types of building, such as look-out posts, signal boxes, sheds, etc.

On the Togo Railways two standard types of buildings have been designed and used according to the importance of the traffic.

The Austrian and Luxemburg Railways replied in the negative, and gave no useful information in connection with this part (1-11) of the questionnaire.

The North of Milan Railway has not used the method, in view of the characteristics of its system.

The building activities of the Deutsche Bundesbahn has been restricted since the end of the war to the reconstruction of the buildings that were destroyed.

As far as the planning and carrying out of this work is concerned, they have to take into consideration local conditions, the need to reuse existing building components and link them up with the present installations. It is not however necessary to elaborate a general system of standardisation for complete buildings or large constructional details.

a) On all the Railways listed above where standardisation of buildings has been applied, it is based on a predetermined plan (Standard plan).

On the S.N.C.B., the standardisation system is also based on a standard unit.

On the D.B., all the standardised units are built according to the usual German standards.

b) The following Administrations replied in the affirmative : D.B., S.N.C.B., S.N.C.F., C.F.F. and Portuguese Railways.

The S.N.C.F. also uses, with good results, double partitions with an air gap between to avoid the transmission of noise through walls.

The N.S. have used with good results a

dividing wall in masonry of  $2 \times 12$  brick which gives sufficient insulation against heat and damp, and is usually satisfactory as regards acoustic insulation.

The *Gafsa Railway* have tried out successfully only acoustic insulators.

The *Greek Railways* gave a negative reply.

The other Administrations did not reply or give any data.

c) On the *D.B.*, *S.N.C.B.*, *S.N.C.F.*, and *C.F.F.*, the building is usually done by private contractors.

The *S.N.C.B.* advised us that only the building of huts and moveable shelters in reinforced concrete is carried out by the railway staff.

The *Portuguese* and *Greek Railways* use their own labour. On the *Gafsa Railway* according to circumstances, the work is done by contractors or by the Administration itself.

d) All the Administrations making use of standardisation of buildings replied that transport and spares did not give rise to any difficulty.

2. — *Has it been found that standardised unit construction has advantages over other forms of construction in regard to*

- a) *economy of first cost?*
- b) *economy of maintenance cost?*
- c) *economy in the use of materials?*
- d) *speed of erection?*

The *S.N.C.B.* and the *Greek Railways* replied in the affirmative, although the former did not allude to the economy mentioned under b).

The *F.S.* replied in the negative and are of the opinion that standardisation of types does not give any particular advantage, apart from reducing the cost of designing the building. They consider however that prefabricated types have certain advantages as regards the initial cost, maintenance costs

and the rapidity with which they can be erected, but their life is relatively short.

In the case of the other Administrations, some state that they cannot give a precise answer to this question; others that they have not sufficient experience of the system or that it has only been used on a small scale, but recognise that it has some of the advantages mentioned.

3. — *Has unit construction been applied to a variety of types of buildings or was it only used for one type, such as simple platform buildings, sheds, etc.?*

The reply to this question for the various Administrations is that resulting from the information given on question 1.

4. — *Has the development of standardised unit construction been related to that of a standard practice in station working, and have there been advantages in this?*

The *S.N.C.F.*, *Gafsa*, *Netherlands* and *Portuguese Railways* did not give any precise details on the question or stated that they did not have sufficient experience to reply.

The *S.N.C.B.* is of the opinion that, in a general way, there is no relation of cause and effect between the standardisation of the work of the station staff and that of the buildings, except in so far as the question of the fittings is concerned, which may be directly influenced by this work.

The *C.F.F.* gave a similar reply, i.e. negative like the *S.N.C.B.* but consider that the fittings and even the booking offices are directly influenced.

The *Greek Railways* stated that they cannot express any general opinion, but the case appears more definite in those buildings where the work follows a typical form (goods depots, service installations for the train staff, etc.) which goes hand in hand with the building used, with real advantage.

The *D.B.* expresses the opinion that the

use of buildings and installations built to standard types give the best possibility of an economic conjunction of all the work.

*5. — Has such a development been linked with a policy to aim at uniformity of appearance and colour treatment in stations?*

The *D.B.*, *S.N.C.B.*, and *S.N.C.F.* replied that in general uniformity of appearance and colour is neither attempted nor desirable. It is merely adopted in the case of small service buildings and buildings of an industrial character.

In the case of other buildings, in particular the passenger buildings, the policy followed is to harmonise them with local conditions as regards adjoining buildings, the regional style of architecture, the climate, tourist traffic, etc.

The *F.S.* according to their reply do not follow such a policy.

The *C.P.* and *C.F.F.* replied in the negative and the *R.E.N.F.E.* states that it has no experience from which to reply.

The *N.S.* are of the opinion that such a policy is one of the arguments for standardisation.

The *Greek Railways* are in favour of following such a policy.

*6. — Has any method been developed of pre-fabricating and factory-assembling small buildings which can be transported complete and placed on prepared sites?*

The *S.N.C.F.*, *C.F.F.*, *N.S.*, *Greek* and *Gafsa Railways* replied in the negative.

The *S.N.C.B.* states that only the component parts are prefabricated, and assembly takes place on site.

The *Portuguese Railways* only use prefabricated reinforced concrete pavilions as telephone boxes.

The *F.S.* has some prefabricated lookout

posts, staff shelters, small sheds, water tanks, etc.

On the *D.B.* certain prefabricated reinforced concrete components are used.

*7. — Has it been found that technical developments in the building industry tend to render any system of standardised unit construction out of date, or was it possible to make adjustments without difficulty?*

The *D.B.*, *S.N.C.B.*, *R.E.N.F.E.*, *S.N.C.F.*, and *Greek Railways* gave very similar replies. Their point of view is that there is no incompatibility between the two factors, since reciprocal adjustments are always possible. However, the *Greek Railways* consider that it is necessary to revise the standards from time to time.

The *Gafsa*, *Netherlands*, *Portuguese* and *Swiss Federal Railways* did not reply, because of their lack of experience in the matter, or because the problem does not arise on their systems.

*8. — Has it been found that standardisation of unit construction is an advantage, because individual initiative to develop new methods of construction is given too little scope?*

The *Deutsche Bundesbahn*, *R.E.N.F.E.*, *S.N.C.F.*, and *C.F.F.* replied that standardisation of unit construction has not the disadvantage indicated in the question.

The *S.N.C.B.* is of the opinion that to a certain extent it may have the drawback in question, but this can be reduced if standardisation is limited to simple constructional components.

The *Netherlands*, *Portuguese* and *Greek Railways* replied in the affirmative. The *Greek Railways* are of the opinion that this is the chief drawback of standardisation, but on the other hand they consider that it opens up a limited and precise field to many building technicians, which is recognised as an important advantage.

9. — *Have fluctuations in the cost of materials or labour had an adverse effect on the application of standardised unit construction?*

The S.N.C.B., S.N.C.F., Netherlands, Swiss Federal and Portuguese Railways replied in the negative.

The Deutsche Bundesbahn and R.E.N.F.E. express the opinion that in given cases fluctuations in the cost of materials or labour can hinder the application of standardised unit construction.

The Greek Railways replied in the affirmative to this question.

10. — *Has scarcity of raw materials been a check on the application of standardised unit construction?*

The S.N.C.F., and the R.E.N.F.E. are of the opinion that the difficulty of obtaining certain materials may hinder standardisation.

The Greek Railways share this opinion in the case of imported materials.

The S.N.C.B., Netherlands, Portuguese and Swiss Federal Railways replied in the negative.

The D.B. points out that the difficulty of obtaining certain materials has had the consequence of making the application of the standards set up impossible.

11. — *To what extent has it been found suitable to use standardised unit construction for small-scale improvements at existing stations?*

The S.N.C.F. is of the opinion that the standard is with difficulty adapted to existing buildings, but recognises as possible the adaptation of typical designs and components.

The S.N.C.B. and C.F.F. report that they have not yet used standardised unit construction in modernising their stations.

In view of their lack of experience, the

R.E.N.F.E., Netherlands, Greek and Portuguese Railways cannot express any opinion on this subject or else the problem does not arise on their system.

The Deutsche Bundesbahn considers that when renewing buildings standardised components can be used, for example roofing and wall components.

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#### B. — Summary of the replies received from the Railway Administrations.

1. — Many of the Administrations consulted make use of the system of standardisation of the units of construction but it is found from the replies received that the application of this method has been limited to current constructions such as the passenger buildings of small stations, service buildings and buildings of an industrial character, such as locomotive sheds, goods depots, etc.

On nearly all the railways at the present time standardised types of small buildings in reinforced concrete are used, such as lookouts for pointsmen, staff shelters, etc. and a few standardised components for simple buildings. Station buildings and buildings other than those of an industrial character are designed and built without reference to any standard plans. The countryside, climate and local customs are taken into account so that the building will not prove a discordant factor in the whole.

a) Usually those Administrations using standardised building, make use of some typical plan as a basis which is adapted to local conditions or service requirements;

b) Nearly all the Administrations have used with success in their buildings insulation against heat, damp and noise;

c) On most Railways, standardised buildings are erected by private contractors;

d) The problem covered by this part of the question does not arise on most Railways.

2. — The information supplied by the Administrations consulted does not make it

possible to get a complete and soundly based idea of the advantages of standardisation compared with other forms of building under the aspects covered by this question. It appears however that, at least from the point of view of initial cost and rapidity of construction, the system has advantages.

3. — The application of standardisation of buildings has been limited as stated under point 1 to current types of buildings or buildings of an industrial character, as well as to standardised types of small prefabricated units or building components.

4. — The information supplied on the question by the different Administrations is not sufficiently precise for any exact conclusions to be arrived at.

5. — From the replies received, it may be concluded that a policy of standardised outward appearance and colour is not usually adopted except in the case of small units or buildings of an industrial character.

6. — Small prefabricated buildings are currently used on many Administrations as stated under No. 1.

7. — From the replies received, it appears that it is possible, without difficulty, to make adjustments in order to reconcile standardised unit construction with the technical progress of the building industry. It appears however that it is prudent to remember the point raised by the Greek State Railways on the advantage of revising the standards from time to time.

8. — Although it is impossible to get a precise idea of the problem to which this question relates, owing to the very different opinions expressed by the Administrations, it appears that to a certain extent the drawback in question is justified.

9. — Regarding the influence of fluctuations in the cost of materials or labour on the application of standardised unit construction, it may be concluded from the replies given by the Administrations consulted that such fluctuations are not likely to prejudice standardisation.

10. — From the information received in connection with this point, it is not clear if the shortage of certain primary materials has been an obstacle to standardised unit construction.

Opinions are divided on this point so that no conclusion can be arrived at.

It appears, however, that the difficulty of obtaining materials would undoubtedly be an obstacle to the application of standardised unit construction.

11. — It cannot be concluded from the replies received that standardised unit construction is applicable to the modernisation of existing stations, seeing that nearly all the Administrations confess that they do not possess the necessary factors for an investigation. However, it appears that the application of typical designs or the use of the standardised components is possible.



## INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th. SESSION (LONDON, 1954).

### QUESTION 8.

# Determination of the principles of geographical and functional organisation of a railway system. Simplification and retrenchment of the administration of railways.

### REPORT

(*Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia*),

by R. DUGAS,

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The principles of organization of Railway Administrations differ in different countries. They are the result, in each country, not only of the nature and of the size of the undertaking, but also of very diverse factors : legislation, historical or political events, the nature of the traffic, the attitude of the staff, etc.

It is at the top level of administration that one finds the greatest variety, because of the limitations which are imposed by legislation; in low-level organization, on the other hand, technical limitations entail a certain similarity between systems.

We are thus led first of all to study the legal structure of Railway Administrations and their higher management.

We will then examine the various executive bodies in the systems, from the top management to the actual operating units,

firstly from the point of view of purely functional organization and subsequently from the point of view of geographical division.

After this essentially documentary section, we will discuss the principles of organization which have been described in this manner and then we will outline the steps which certain administrations have taken or propose to take with the object of simplifying their organization and reducing their administrative staff.

#### I.

### LEGAL CHARACTER AND HIGHER MANAGEMENT OF RAILWAY ADMINISTRATIONS.

Railway Administrations can be classified

in three main categories according to their legal status :

- State Railways;
- Partially State-owned companies;
- Limited or private companies.

In the case of the first of these categories, it is convenient to set apart, from the point of view of administration, those consisting of a State Administration (as in Algeria and the Federal German Republic) and also those whose higher management is the responsibility of a ministerial department (as in Italy) or a senior civil servant answerable to a ministerial department (as in Austria).

The administration of the railways of Overseas France can also be included in this sub-category; although they constitute commercial and industrial entities with a legal and financial identity, they are placed under the overall control of a state department : the Central Office for Overseas France.

The other railways in the first category are public undertakings endowed with administrative independence. This is the case in Spain, in Greece (C.E.H.), in Switzerland (C.F.F.), in Syria and also in the Belgian Congo.

In the category of partially State-owned companies are to be found those of Belgium (S.N.C.B. and S.N.C.V.), and France (S.N.C.F.). The greater part of the capital of these companies is held by the State.

Finally, certain Railway Administrations constitute limited companies. In some cases the State may hold part of the capital, as in Holland, Portugal, Morocco and Switzerland (Bernese Oberland Railways and Rhaetian Railway). In others, the State retains no share, except to reserve the right of control; these are true private companies (as in the cases of the Nord Milano Railway and the Compagnie du Chemin de Fer de Gafsa).

We will now examine in turn the various examples quoted :

#### A. — State Railways

(where the management is derived directly from the State Administration).

##### *Algeria.*

The administration of the Algerian Railways (C.F.A.), is a special organization charged with the duty of operating all the railways in Algeria. It is placed under the authority of the Governor General of Algeria; it is a corporate body and is financially independent.

There is a managing committee which includes a Chairman, a high official of an Algerian financial organization, a member of the Bridges and Roads Service or the Mines Service and a member chosen from amongst persons who have rendered special service to the railways.

The Chairman and the Committee members are nominated for three years by the Governor General. Two Government Commissioners (the Director General of Finance and the Director of Public Works and Transport) take part, in a consultative capacity, in the managing committee's proceedings and, in the name of the Governor General, exercise control over the running of the system. The general manager of the system is present at the Committee's meetings and may be accompanied by the senior officers of the system.

There is also a Consultative Council, consisting of 8 members of the Algerian Assembly, a member of one of the Chambers of Commerce of each department (three in number), one member of the General Association of Algerian Farmers for each department, an official of the Finance Department, three engineers from the Bridges and Roads Service or Mines Service, two members drawn from amongst persons who have rendered eminent service to the railway, and three members of the C.F.A. staff, chosen by the delegates to the system's various committees or commissions.

The Chairman of the Managing Com-

mittee is ex officio Chairman of the Consultative Council.

The General Manager, the Assistant General Manager and the departmental heads, when called upon by the General Manager, have the right to be present at Council meetings.

The Managing Committee considers the following subjects, as put forward by the General Manager : budget, annual reports, yearly programme for major new works, proposals for important works, supplies programmes, important purchasing proposals, acquisitions and sale of goods and property, fares and charges, train services and timetables, and regulations on recruitment, promotion, discipline and various remunerations.

The Consultative Council must be called upon the General Manager to give its opinion on the following subjects; yearly programmes for major new works, important supplies and works programmes, fixing or alteration of fares and charges, train services and timetables and any matter referred to the Council by the Governor General or by the General Manager of the C.F.A.

Questions are considered, both in the Council and in the Management Committee, on a majority vote basis.

#### *Federal Germany.*

Under the name of « Deutsche Bundesbahn » (D.B.) the Federal German Republic administers the assets represented by the federal railways as a public undertaking which does not enjoy a status independent of the State but is endowed with its own administration and is financially independent. The administration of the D.B. is a federal administration. It is to be noted that the law on which the constitution of the D.B. is based specifies that this administration can complete contracts, bring actions and be brought to law; that the state does not guarantee the D.B.'s liabilities except with the railway's assets and that, in turn, the State cannot have recourse to railway assets to guarantee other state debts.

The Management of the D.B. is entrusted to an Administrative Board and to a Managing Committee. The Administrative Board consists of 20 members, appointed for five years by the Federal Government and divided into 4 groups of 5 :

Group A : National Assembly;

Group B : Economic organizations;

Group C : Trade Union organizations;

Group D : Other members.

Members are selected as follows :

for Group A : from names proposed by the National Assembly;

for Group B : from names proposed by the central industrial, commercial, agricultural and users' organizations and the guilds;

for Group C : from names proposed by the unions;

for Group D : from names proposed by the Federal Minister of Transport.

Members of the Federal Government have the right to be present or to be represented at all Board meetings. They may also speak there.

The transactions and decisions of the Board are prepared by special Committees whose members are chosen from among the members of the Board.

Amongst the powers of the Board may be mentioned the nomination of members of the Managing Committee, the appointment of officials to executive positions in the top management (Hauptverwaltung) and to the position of regional chairmen, matters of policy which affect the staff, participation in other undertakings, demands for credits and borrowing, questions of tariffs which seriously affect the financial position of the D.B., and important changes in organization. In a broad sense, the Board has the power to decide questions of a general nature, and may even, at its own discretion, acquaint itself with individual problems of particular importance.

It is to be noted that no provision is

made for the delegation of the Board's powers to its chairman or members.

The authority of the Board is at all times restricted by the Federal Minister of Transport's power of control and of veto.

#### *Italy (F.S.).*

The administration of the Italian State Railways (F.S.) is an integral part of the Ministry of Transport and is placed under the overall control of the Minister, who is assisted by two Under-Secretaries of State in respect of a group of functions delegated to them. Thus this Administration has no identity separate from the State; it none the less enjoys administrative, accounting and financial independence.

There is an Administrative Board whose function is consultative. Its chairman is the Minister of Transport and the following are members : the two transport Under-Secretaries of State, the General Manager, three Officials of the F.S. chosen by the Minister of Transport, two judges from the Council of State, two Officials representing the Treasury, one Official representing the Ministry of Public Works, one Official representing the State Attorneys-General, three staff representatives, three non-official persons who have shown high technical and administrative ability in transport matters.

A senior Army officer is attached to the Board, without voting powers, as representative of the Ministry of Defence.

The Board members are appointed by a decree of the President of the Republic from nominations by the Minister of Transport put forward through the Cabinet.

The competence of the Board extends over the following matter upon which it must be consulted :

key orders, the powers and functions of departments and offices, the budget forecast and its revision, the distribution between departments of funds allotted in the budget, removal of funds from reserves for unforeseen expenditure, important works projects, supplies, purchase and sale of equipment, important contracts, materials,

important law suits, property transactions and lettings, proposals to modify conditions of and charges for transport, temporary reductions in charges, general proposals concerning the principal train timetables and important changes in these timetables, proposals for new lines, general works programmes, abandonments, substitution for and withdrawal of rail services, changes involving a substantial alteration in the nature of the system, construction of stock, regulations concerning police, security and regularity of operation, specifications for tendering for works, supplies, repairs, sales and leases, proposed regulations concerning staff, holding of competitions to recruit staff, nominations, promotions, etc.

#### *Austrian Railways (Ö.B.B.).*

The General Management of the Austrian Federal Railways forms a part of the Ministry of Communications. The General Manager is thus a High Official of this Ministry. It is to be noted that he is not responsible to any Administrative Board and that the General Management does not include any consultative committee. The powers of the General Manager are detailed in Chapter II of this report.

#### *Overseas France (railways with separate statutory administration « en régime »).*

The General Management of the Railway Administrations of Overseas France is provided by a central body at Paris called the Central Office of the Railways of Overseas France, under the authority and control of the Secretary of State for Marine and Colonial Affairs.

The Central Office is administered by a Board, whose headquarters are at Paris and whose Chairman is appointed by decree.

The Board can delegate some or all of its powers to its Chairman as well as to a Managing Committee.

The working is in the hands of « Régies », organizations of industrial and commercial character, the status, administration

and operating of which are fixed by ministerial decree.

To be specific this is the form of organization of :

the French West African Railway Administration;

the Cameroons Railway Administration; the Madagascar Railway Administration.

The organization of these administrations is very similar. By way of example, and to avoid repetition, we will examine simply the French West African Railway Administration.

The French West African Railway Administration (Régie des Chemins de fer de l'A.O.F.) is run by a Board with 24 members, the Chairman being the Secretary General of the General Government of French West Africa. This Board includes 10 representatives of the Government, 4 of the Grand Council of French West Africa, 5 of the staff and 3 of the users.

The Board performs or authorises all acts and operations concerning the Administration which are not included among the functions of the Minister, the Governor General or the Central Railway Office. It thus holds very extensive executive powers.

Except in so far as concerns programmes for extension, general regulations, budgets, standard charges, accounts and audit and stocks, the Board delegates its powers to a Managing Committee, which must act within the framework of the programmes approved and the credits made available by the Board and which must give an account of its management. The Managing Committee consists of 9 members of the Board.

#### B. — State Railways with administrations distinct from the State.

##### *Spain.*

The system (R.E.N.F.E.), which is State property, is an asset with a legal identity separate from that of the State. It is charged with the operation, as an industrial undertaking, of the railways entrusted to it by law.

It is administered by a Board responsible to the government for the management of

the system and its supplementary or subsidiary operations.

The Board comprises the following : Chairman, the Manager of the System, three Board members, representing the Ministry of Public Works, two representing the Ministry of Finance, one each representing the Ministries of the Army, of Agriculture, of Industry and of Commerce, a representative of the National Delegation of Unions, four economic or financial specialists, the Government Delegate for Transport Authorisation and the Manager of the Railway Equipment Commissariat.

The Chairman is appointed by the Government; the other Board members are also appointed by the Government from proposals by the Ministry of Public Works and after occasional nomination by other Ministers. The Government Delegate for Transport Authorisation, the Manager of Railway Equipment and the Manager of the System are ex officio members of the Board. The Board nominates the Deputy Chairmen from amongst its members.

The following are the most important of the Board's functions : to manage, to supervise and act on behalf of the State Railways, to put before the Ministry, for its approval, charges, proposals, new works proposals and also the annual budget; and to present the annual report on the operation of the system.

An Executive Committee is appointed from amongst the members of the Board; it consists of the Board Chairman, who is also the Committee Chairman, two of the representatives of the Ministry of Public Works, the two representatives of the Ministry of Finance, the representatives of the Ministry of Industry and Commerce, two of the technical Board members and the Manager of the System. The appointment of the Board members who make up the Committee is carried out by the Ministry of Public Works.

The Board can delegate to the Executive Committee such powers as it considers necessary for the most efficient running of the undertaking.

*Greece.*

By statutory provision, the organization, administration, management and operation of the system are entrusted to a company called the « Hellenic State Railways » (C.E.H.) endowed with an independent legal identity.

The top management of the C.E.H. is undertaken by an Administrative Board consisting of thirteen permanent and nine non-permanent members.

The permanent members are : the Army Chief of Staff (or his deputy), the Governor of the Bank of Greece (or his deputy), the Governor of the Agricultural Bank of Greece (or his deputy), the Director General of the Public Accounts, the heads of the Railways and Bridges courses at the Polytechnic School, a professor of law from the School of Law at the University of Athens, nominated by the Ministry of Communications and six other members also nominated by the Minister of Communications.

The non-permanent members are : the Naval Chief of Staff, the Air Force Chief of Staff, a representative of each of the Chambers of Commerce and Industry of Athens, the Piraeus and Thessalonica, chosen by the Minister of Communications from two candidates nominated by each of these Chambers, the Director General of the Tourist Bureau, one of the directors of the Ministry of Communications who is concerned with road transport, a staff representative chosen by the Minister of Communications from three candidates proposed by the staff, and the head of the Bridges department of the Polytechnic School.

In addition a Government Representative sits on the Administrative Board.

The Board has the power to consider any matter except those which the law on the running of the C.E.H. reserves specifically for the Cabinet, the Ministers of Communication and Finance or the General Manager.

We may mention that the Board supervises the whole of the Administration, examines the budget and decides upon alterations to it, examines the audit and compiles the accounts of the operations of the completed period, fixes the principles of the charges system and decides upon modification to charges, decides on agreements to be concluded with other transport undertakings, approves the amount of work planned on building, permanent way and rolling stock, approves provision for or execution of works of a prescribed value, decides upon purchase and sale of property, approves staff regulations as well as technical, commercial accounting and financial regulations, decides upon the form of reserve funds and the uses to which they should be put, studies the needs of the system in a general manner and makes the necessary proposals to the Minister. Staff rates of pay are always decided by the Government.

It is to be remarked that the Board delegates none of its powers.

*Switzerland (C.F.F.).*

The management and operation of the railways belonging to the Swiss Confederation or leased thereto, are entrusted to an independent administration called the Swiss Federal Railways. This administration has no legal authority apart from the State but can, none the less, bring and be brought to law and must balance its books.

The Swiss Federal Railways has an Administrative Board of 15 members, appointed for 3 years by the Swiss Federal Council and eligible for re-appointment. In choosing these members, account is taken of the linguistic regions of the country, of the political parties, of the major economic bodies (Swiss Union of Commerce and Industry, Swiss Peasants' Union, Swiss Union of Arts and Professions). One Board member represents the main Railway Trade Union. The representatives of major economic bodies are considered, in addition, to represent the users.

The powers of the Board are defined by a Statute and an Executive Order.

### *Syrian State Railways.*

The status of the Syrian State Railways (Northern Lines) is that of a body endowed with legal and financial independence.

There is an Administrative Board of 9 members, of which 5 represent the Government. The Staff are not represented. The Board's powers are directed mainly at the fixing of staffing standards and staff regulations, the rules for fixing the budget, the advance of funds for new works and important supplementary works, general rules on operation, charges, tenders and sales of considerable value and the audit of the system's accounts.

### *Belgian Congo.*

The Colonial Transport Office (OTRACO) is a public organization with a legal and financial identity distinct from that of the State. It is managed by an Executive Board all of whose members, eleven in number, are appointed by the King.

The Board has very extensive powers. In certain matters, its powers are subject to ratification by the Minister of Colonies : disposal of property, amalgamation with other undertakings or participation therein, staff remunerations, loans.

The Board delegates some of its powers to a Managing Committee.

## C. — Partly State-owned Companies.

### *Belgium (S.N.C.B.).*

The Belgian National Railway Company is a company endowed with financial and administrative independence. The State retains a reversionary interest in the system and controls five-sixths of the votes at Meetings. Though legally incorporated as a private body, it is, nonetheless, an administrative organization formed by higher authority and authorised by it to provide a public service.

The Board of Administration consists of 21 members, 18 appointed by the King and 3 by the staff. The Minister of Communications has the right to take the chair at Board meetings and has the right to vote.

The Board's powers are particularly extensive. It is useful to note the following limitations : the Government has the right to require the lowering of charges or to forbid their increase. The following matters are submitted for ministerial approval : disposal, acquisition or sale of property, tenders and deals involving large sums, the investment of liquid assets. Extensions of the system and loans must be authorised by Statute.

### *Belgium (S.N.C.V.).*

The Belgian National Light Railway Company is a company of the commercial type endowed with a legal and financial identity distinct from that of the State. None the less, the State, through the agency of the Ministry of Communications and the Ministry of Finance, exercises certain rights of supervision and control which are fixed by law and the Company's statutes.

The Company is administered by a Board consisting of a Chairman and six officials, and by a General Manager. The Chairman of the Board, who has the power to suspend its decisions, is appointed by the King; one half of the other members are appointed by the King and one half by the General Meeting of Shareholders.

Neither the staff nor the users are represented on the Board.

To assist in the exercise of their control and in the study of matters of a technical nature and of those which, in any respect, affect the public finances, the Minister of Finance and the Minister of Communications each appoint a Government Commissioner who attends Board meetings, when he considers it desirable.

There is also an Overseeing Committee, consisting of nine Commissioners. They are appointed by the General Meeting and may be recalled by it.

The Board is invested with very extensive powers for the running and administration of the Company and can delegate certain of these powers to the General Manager.

*France (S.N.C.F.).*

The French National Railway Company is a mixed-ownership Company in which the State holds a controlling share of the capital (51 per cent), the remainder belonging to the former Railway Companies.

The S.N.C.F. is administered by a Board comprising 20 members, to wit :

a) Ten members appointed from officials serving in State Administrations :

- two members of the Council of State;
- three members of one of the major state services or of the General Inspector of the Public Services Corps;
- three Officials from the National Economy and Finance departments;
- two officials from the Bridges and Roads Service and the Mines Service.

These officials are appointed by a decree countersigned either by the Minister of Public Works and Transport, for officials from his department or by the Minister of Public Works and Transport, of the National Economy or of Finance for other officials;

b) Five members appointed by the Boards of the former Railway Companies;

c) Five members representing the staff, appointed by a decree countersigned by the Minister of Public Works and Transport from nominations by trade union organizations.

The Members of the Board are appointed for 6 years. The Chairman of the Board is chosen from the officials of group a). He is appointed by a decree countersigned by the Minister of Public Works and Transport, the Minister of Finance and the Minister of the National Economy.

One of the Vice Chairmen is appointed in the same manner. A second Vice Chairman is chosen from members in group b).

Thus the representatives of the State are in the majority on the Board, in the event of even division of votes, the Chairman has the casting vote. In addition, the Director General of Railways and Transport at the Ministry of Public Works and Transport has a seat on the Board as a Government Commissioner; he may require that such matters as he sees fit shall be included in the agenda. In addition, a Financial Control Commission for Railways has been set up by the Government; the head of this Commission also has a seat on the Board. He must prepare a written recommendation on all proposals submitted to the Board concerning the operational and investment budgets, and also on the annual accounts. He must advise on all capital investment carried out by the S.N.C.F. and its subsidiaries. The head of the Financial Control Commission may, like the Government Commissioner, demand that the Board consider a question a second time in certain circumstances.

The Board controls the Company's general policy and takes note of all important matters : budgets, projects, purchasing, charges, etc.

The Board has extensive powers, under the statutes, in all matters concerning management and administration.

To further the Board's work and to prepare for its meetings, a large number of committees, each one consisting of several officials, examine the budget proposals, follow the course of affairs in the Treasury and in the non-budgeted accounts, supervise arrangements for purchasing, etc. In particular, six budgetary Commissions have been set up. They consist entirely of officials, but include, however, representatives of the staff and private interests as well as of the State. They are charged with the examination of the requests for credit which are put forward by the departments and must search out all possible economies.

The Board delegates some of its powers to its Chairman. In particular, he approves projects, the purchase of supplies and con-

tracts for works up to a certain value. He has the power to deal with particularly urgent matters, even if they are outside his authority, on condition that he accounts for them to the Board at its next meeting.

#### D. — Limited Companies.

##### *Netherlands.*

The Administration of the Dutch Railways forms a limited company. It is endowed with a corporate identity in common law which is distinct from that of the State. None the less, the State is the only shareholder.

There is an Administrative Board with a maximum of 16 members, appointed by a General Meeting of the shareholders, that is to say, the State.

All members are appointed indefinitely. No direct Government representation is prescribed, but the Secretaries General of the Ministry of Transport, the Ministry of Finance and the Ministry of Economic Affairs are normally members of the Board. Neither staff nor users are represented on the Board.

The Board is a controlling body with a certain number of functions reserved to it, such as the following :

authorisations to borrow, the approval of budgets, the presentation of audits and profit and loss accounts, authorisations to operate transport undertakings other than railways and tramways and also auxiliary undertakings, approval of participation in undertakings, authorisations to carry out works and to purchase equipment above a certain value, authorization to buy and sell property above a certain value, the appointment of the General Secretary and Departmental Chiefs and the fixing of their salaries.

The Board has no powers over charges questions.

It does not delegate its powers to its Chairman or to a sub-committee.

##### *Portugal.*

The administration of the Portuguese Railways also is constituted as a limited company endowed with a corporate identity distinct from the state and financially independent.

The Administrative Board consists of seven members, of which four are chosen by the General Meeting and three are appointed by the Government. There is a Chairman named by the Government and a Vice Chairman and a Delegate Administrator chosen yearly by the Board.

The staff and the users are not represented on the Board.

The Board enjoys full administrative powers, including, in particular, powers relating to equipment, rates of pay to staff, charges, an the budget.

The Delegate Administrator conducts the day-to-day administrative business, carries into effect the views of the Board and exercises those powers delegated to him by the Board.

##### *Switzerland (B.L.S.).*

The Bernese Alps Berne-Loetschberg-Simplon Railway is a limited company with a large number of its shares held by the State.

Its Administrative Board consists of shareholders' Representatives and State Representatives. It numbers about thirty members. Amongst its statutory functions are included the approval of the budget, the annual accounts, timetables, control of credits of a certain value and the appointment of the Manager.

The Board elects a Managing Committee (seven Members), which meets as required and may be considered as constituting the management of the system.

##### *Switzerland (Rh.B.).*

The Rhaetian Railway is a limited company, and is private in its legal form.

The Administrative Board consists of

28 members representing the State, the Canton of the Grisons and the private shareholders.

A committee of the Board, consisting of 7 members, watches over the execution of policy and prepares questions for consideration by the Board.

#### *Morocco.*

The Moroccan Railway Company is a French limited company which is the subject of a concession by the Sherifian government. This company carries an Administrative Board consisting of a Chairman, two Vice Chairmen and 8 Administrators. A Sherifian Government Commissioner attends Board meetings. The Administrators are appointed by the General Meeting for periods of 6 years and are always eligible for re-appointment. Each year, the Board chooses a Chairman from amongst its members. The latter can appoint a Committee consisting either of Administrators or of officers and Administrators and the Manager of the company.

The Moroccan Railway Company is placed under the control of the Public Works Directorate of Morocco.

#### E. — PRIVATE COMPANIES.

##### *Italy (Nord Milano).*

The « Nord Milano » Railway is administered by a private company endowed with a corporate identity distinct from that of the State and with financial independence.

The Administrative Board consists exclusively of representatives of holders of share capital.

The Board has very extensive powers over the management of the company, without limitation of any kind. It is free to do anything it may consider necessary to further the common purpose, apart from acts specifically reserved by law for the Meeting. Thus, it is free to buy, sell or exchange property, to provide for the con-

struction, maintenance and operation of railways, tramways, aerial ropeways, road and air transport. It may conclude agreements on these matters with the State, local organizations, companies, firms and individuals; it may accept registrations, entries of satisfaction and accounts for mortgages; it may compound or compromise on any matters not forbidden to it by law and may authorise or perform any business with any organization, public or private.

The Board may delegate to one or more of its Members, acting either collectively or separately, the power to sign for it or to represent it and also the necessary powers to act for the company; thus, it can appoint one or more Board members as its delegates or as an Executive Committee and can entrust special tasks to individual officials.

##### *Gafsa Railway Company.*

The Sphax-Gafsa Railway is a department of the Gafsa Phosphates and Railway Company and is thus under the direction of that company. The Board includes no representatives of the government, the staff or the public.

The Railway is run at the expense, risk and peril of the Company. The Board has full powers in respect of equipment and staff rates of pay: with the reservation that the Directorate of Public Works of Tunisia may exercise its powers. Charges, in particular, are fixed by this Directorate.

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## II.

### GENERAL MANAGEMENT.

In the case of most Railway Administrations, the organization is directed by a General Manager, assisted in some cases by Deputy General Managers and by a General Secretary. Details are given in table below (page 959/61).

In a limited number of organizations, there is a Managing Committee, consisting of high ranking men, under the chairman-

	General Management	General Secretariat		NOTES	
		General Manager	Deputy General Managers		
Group General Management	General Manager	Deputy General Managers	Other Officials assisting the General Manager	General Secretary reporting to the General Manager	Assistant General Secretaries reporting to the Board of Administration
<i>French West Africa</i> .	1 (a)	1	—	1	(a) Federal Manager
<i>Algeria</i> . . . . .	1 (b)	—	—	—	(b) Manager
<i>Federal Germany</i> . . . . .	×	1 (c)	2	1	(c) Ministry Official
<i>Austria</i> . . . . .	1	—	—	1	(d) Manager
<i>Belgium</i> (S.N.C.B.) . . . . .	—	—	—	—	(e) Deputy Managers
<i>Belgium</i> (S.N.C.V.) . . . . .	1	1	—	1	(f) Assistant Managers assist the Manager and the Deputy Managers.
<i>Belgian Congo</i> (Ofraco)	1	1	—	—	(g) a Research Department comes also under the Board.
<i>Spain</i> . . . . .	1 (d)	4 (e)	(f)	1 (g)	(h) The General Secretary reports direct to the Chairman of the Board on financial matters.
<i>France</i> . . . . .	1	2	1 (h)	1	(i) In the event of absence of the General Manager and the Deputy General Manager they are replaced by a Member of the Board appointed by the Board.
<i>Greece</i> (C.E.H.) . . . . .	1	1 (i)	—	—	(j) Vice General Managers
<i>Italy</i> (F.S.) . . . . .	1	2 (j)	—	—	(k) Delegate Board Member who is also General Manager.
<i>Italy</i> (Nord-Milano), <i>Morocco</i> . . . . .	1 (k) 1 (l)	—	1 1	1 1	(l) The positions of Chairman of the Board and General Manager may be combined in one person.
<i>Netherlands</i> . . . . .	—	1	1 (m)	(n)	(m) Deputy General Manager
<i>Portugal</i> . . . . .	—	—	—	—	(n) Three Deputy Managers and several Assistants help the General Manager and the Deputy General Managers.
<i>Switzerland</i> (C.F.F.) . . . . .	—	—	—	—	
<i>Switzerland</i> (B.L.S.) . . . . .	—	—	—	—	
<i>Switzerland</i> (Rh.B.) . . . . .	—	—	—	—	
<i>Syria</i> . . . . .	—	—	—	1	

ship of one of their number and fulfilling as a body the role played in other organizations by the General Manager. This is the case with the German Federal Railways, the Dutch Railways, the Swiss Federal Railways. The circumstances are detailed below.

#### *German Federal Railways.*

The executive management of the German Federal Railways (D.B.) rests with a Managing Committee. This Committee consists of four members with equal rights, appointed for five years by the Federal President. One of these Committee members is Chairman.

The Committee takes decisions on a majority vote, in the case of equal division, the Chairman has a casting vote. As we have already explained, the Managing Committee is bound by the directives it receives from the Administrative Board.

The members of the Committee are nominated by the Federal Minister of Transport, with the agreement of the Board. If agreement proves impossible, the Federal Government takes the decision. The Chairman of the Managing Committee, who must be appointed first, must be consulted on the choice of the other Committee members.

It should also be noted that the Managing Committee's powers are defined by the law on the German Federal Railways and are not fixed by the Chairman of the Board. Since the law decrees that members of the Managing Committee have equal rights, the resultant form of collective management does not allow functions to be divided between the different Committee Members.

#### *Dutch Railways.*

The administration of the Dutch Railways is directed by a Managing Committee consisting of a Chairman and a maximum of three General Managers, appointed by the General Meeting of Shareholders.

The law and statute concerning the system entrust to the Managing Committee the running of the Company. Many of the powers in respect of railways which are enjoyed by the Government by virtue of the provisions in the law, have been delegated to a Managing Committee. It is to be noted that the Managing Committee's powers are not delegated to it by the Chairman of the Board.

The Managing Committee acts as a single unit. The Chairman may overrule the other members. The Chairman and the General Managers divide out amongst themselves their functions.

#### *Swiss Federal Railways.*

The administration of the Swiss Federal Railways is controlled by a general management consisting of a Chairman and two General Managers.

The powers of the general management are fixed by law and by the standing order passed by the Board.

By the ruling of the law, the general management « exercises the higher management and running of the undertaking, subject to the limitations imposed by the powers of the Board. It supervises the overall running of the system and takes such measures as are required to adapt it to the needs of the traffic and to technical innovations ». The Chairman of the General Management « represents the Federal Railways Administration from the point of view of the public and supervises the process of administration ».

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#### III.

#### CENTRAL SUPERVISORY BODY.

In all systems of a certain level of importance, the General Management consists of, or is assisted by, bodies which help it in the execution of its duties and thus constitute the central supervisory body. Their numbers vary greatly according to the Administration.

We will examine below the case of each Administration and indicate briefly the functions of each of these bodies. Then we will specify whether these latter actually run the concern or whether they only carry out duties which cannot be entrusted, without inconvenience, to bodies lower down the chain of command.

In addition, research, control and executive organizations are sometimes attached to the General Management. We shall point out, in appropriate cases, the existence of such organizations where they do not form a part of central supervisory bodies. On the other hand, we shall not, as a rule, discuss the various departments which may be linked to the railways, but which are not strictly speaking an integral part of the railway undertaking (road and water services, hotels, etc.). Neither will we examine those Railway Administrations in which, owing to the lack of importance of the system, the central supervisory body is merged with regional or local supervisory bodies.

As some indication, we show in the table on page 962/64 of this report the numerical strength, in the principal Administrations, of the staff of the central supervisory body and of the total staff of the subordinate supervisory bodies. At the same time we will call to mind the size of each system in terms of length of line in service and the total number of staff and also the density of traffic, as measured by the trains run and the volume of traffic carried.

#### *French West Africa.*

The General Management of the French West African Railway Administration has at its command a controlling and supervisory body which includes, in addition to the General Secretariat, the Administrative and Welfare Department, the Finance Department, the Commercial Department, the General Supplies Department and the Technical Department.

These different Departments are manag-

ed and co-ordinated by the Deputy Group Manager. Apart from the Finance Department, whose head is also Accounts Officer of the Administration, they do not run the undertaking in any sense. Their function is to collaborate under the direction of the Deputy Group Manager, in carrying out the functions of the General Management.

#### *Algeria.*

The Management of the Algerian Railways enjoys the services of certain Central Departments : General Management Departments (Secretariat, Staff, Litigation, General Accounts, Medical Service); Central Operating Department (timetables, charges, traffic, operation of stations); Rolling Stock and Motive Power Department (acquisitions, scrapping, maintenance of rolling stock, control of train working, motive power matters, requisitioning of motive power, supplies); Permanent Way Department (permanent way work, building and civil construction, maintenance of fixed equipment, supply of permanent way material, electrical department).

The Departmental Heads wield powers specially delegated to them by the Manager.

#### *Federal Germany.*

The Managing Committee has under its orders a body called the « Higher Railway Administration » (H.V.B.). This body includes seven departments, to wit :

I - Staff Department; II - Rolling Stock, Motive Power and Supplies Department; III - Operating Department; IV - Permanent Way and Buildings Department; V - Commercial and Charges Department; VI - Finance Department; VII - Legal Department.

Besides these departments, there are special sections concerned with matters of organization, with publications and with matters concerning senior staff. These come directly under the Managing Committee.

**Statistical Information (¹).**

	Length of line in kms.	Trains run in train kms (millions)	Traffic		Total staff of system	Total number of supervisory staff	Number of Staff of Central supervisory Body	Number of Staff of other supervisory Bodies
			Passengers- km. (millions)	Tonnes-km. (millions)				
<i>French West Africa</i> .	3 754	8.4	512	562	15 857	1 337	211	1 126
<i>Algeria</i> .....	4 372	—	847	1 366	15 869	1 235	264	971
<i>Federal Germany</i> .....	30 480	490	29 716	49 886	504 223	29 854	565	29 289
<i>Austria</i> .....	5 959	58.4	4 671	6 315	76 893	3 801	714	3 087
<i>Belgium (S.N.C.B.)</i> ..	5 030	75.5	7 253	6 630	87 304	5 442	3 026	2 416
<i>Belgium (S.N.C.V.)</i> ..	3 167	66.5	1 726	39	10 455	715	323	392
<i>Spain</i> .....	12 961	89	7 284	7 005	136 114	13 424	5 706	7 718
<i>France</i> .....	41 236	378.8	28 095	49 139	428 900	27 604	1 980 (²)	25 624
<i>Greece (C.E.H.)</i> .....	1 244	5.24	515	149	7 225	881	376	505
<i>Italy (F.S.)</i> .....	16 312	189	21 092	11 598	167 466	22 697	6 871	15 826
<i>Morocco</i> .....	1 092	5.3	526	1 375	7 041	909	155	754
<i>Netherlands</i> .....	3 210	55.9	6 291	3 256	34 824	4 986	3 021	1 965
<i>Portugal</i> .....	3 571	18.2	1 268	637	28 162	5 312	528	4 784
<i>Switzerland (C.F.F.)</i> .	2 974	65	5 832	2 406	35 023	2 187	929	1 258
<i>Switzerland (B.L.S.)</i> .	250	3.8	173	109	1 651	129	129	—
<i>Switzerland (R.h.B.)</i> .	394	3.2	110	17	1 275	71	71	—
<i>Syria</i> .....	248	0.3	6	39	996	180	180	—

(¹) Average figures recorded for the year 1951 and either provided directly by the Administrations in question or taken from the I.U.R. digest of statistics. In view of the variety of sources, these figures cannot be considered to be fully comparable one with another, at least so far as the figures for supervisory bodies are concerned; none the less, they are of value in fixing orders of magnitude in this respect. These provide quantitative information which can be related to the qualitative information set out in the remainder of the report.

(²) Not including the Finance Departments (1 328 members of staff), which are run by the General Secretary, under powers delegated by the Chairman of the Board.

The functions of each of the above Departments can be summarized as follows :

Department I : Staff regulations, staff, railway medical service.

Department II : Rolling stock and motive power, workshops, construction of rolling stock, supplies, electrification (including overhead equipment, sub-stations, electric locomotives and motor coaches, power stations and lighting), road and water technical departments.

Department III : Operating Department (except for handling, carriage of passengers and freight, forwarding of wagons and use of locomotives).

Department IV : Permanent Way and Buildings (structures, fixed equipment, signalling and telecommunications, inspection of railway, safety measures at level crossings, building construction).

Department V : Commercial and Charges (including handling, carriage of passengers and goods, forwarding and servicing of wagons, road commercial department).

Department VI : Finance, accounts, treasury (including statistics).

Department VII : Legal matters and railway legislation.

Managers are placed in charge of these Departments, corresponding in rank to Ministerial Directors in the Federal Administration. They work on the basis of instructions and general directives given by the Managing Committee.

In addition, the South, West and Central Movement Control Departments should be considered as attached to the H.V.B. Their task is to direct, in the name of the H.V.B., train movement and traffic in their zone.

The H.V.B. is also used to look after certain special matters which concern the system as a whole, namely the following central Departments :

— the two Central Technical Offices (E.Z.A.) of Minden and Munich. Their

function is to centralize purchasing, construction and experimental work for the system as a whole. The organization of these offices is similar to that of the Managements that we shall study later. They have a Chairman in charge;

- the Welfare Office;
- the Central Wagon Office;
- the Central Efficiency Office for the Workshop Department and
- the International Passenger Traffic Office.

Generally speaking, the H.V.B. give orders on matters of financial, staff and traffic policy. Its functions also extend to economic and technical matters involving questions of policy.

#### *Austria.*

The General Management consists of five Central Management Bodies (Operating, Finance, Commercial, Motive Power, Works), and four Central Departments (Litigation, Supplies, Electrical Department, Road Transport Department). The Central Managements differ from the Central Departments only in the smaller number of staff of the latter or in the fact that they are not directly required in the operation of the system.

The officials who report direct to the General Manager are, as a general rule, empowered to take decisions, within their proper spheres, in the name of the General Manager in so far as the latter does not himself expressly withhold particular questions. In special circumstances, the General Manager may entrust to those officials duties which exceed their normal responsibility.

The Austrian Railways are, in addition, transporters by road and waterway, and have a Workshops Department; the Road Transport section is a central Department of the General Management, and Water Transport and Workshops are the responsibility of the Motive Power Management.

*Belgium (S.N.C.B.).*

Seven Managers are placed under the orders of the General Manager of the S.N.C.B., at the head of the main departments, viz.: Operation (arrangements of train service, movement), Rolling Stock and Purchasing (train motive power, maintenance and repair of rolling stock, all purchasing required by the Company), Permanent Way (construction, maintenance and renewal of permanent way, buildings and civil construction), Finance (accounts, treasury, deeds, control of expenditure and receipts, control of purchasing and stores, statistics and costs), Staff and Welfare (including medical and welfare matters), Commercial (charges, development of traffic, publicity, concessions, bus services, commercial agencies), Electrical and Signalling (including fixed installations for electric traction, signalling, telecommunications).

The Managers of these Departments enjoy powers delegated by the General Manager.

There is also a Technical Secretariat and an accident department which report directly to the General Manager.

*Belgium (S.N.C.V.).*

The General Management is assisted by a General Inspectorate (general research, organization, duplicating, information, accident prevention) and by five Management Bodies : Way and Works, Motive Power and Rolling Stock, Operation, Staff, Finance and Accounts.

In addition, a Secretariat deals centrally with matters of litigation, acquisition and disposal of property, accident insurance, etc. A Purchasing Department makes important purchases on behalf of the whole Company.

In principle, all orders and instructions of any sort, whether they are addressed to the Central Administrative Managers or to local Heads, are given by the General Management. On the basis of these instructions, the Central Administrative Managers

come to fulfil, in the name of the General Manager an executive function in respect of the local Heads.

*France (S.N.C.F.).*

In the French National Railway Company there are, strictly speaking, no Central Departments. But the General Management includes Managing Departments, whose functions are listed below. Certain specialized executive research and control bodies, whose activities are not subject to geographical limitations, are also under the immediate orders of the General Management; authority over certain of these bodies rests with the Managing Departments referred to above.

The following are the functions of the Managing Departments :

Staff Department : General rates of pay, welfare questions, pensions, medical service.

Operating Department : General consideration of problems concerning transport, the organization of forwarding of goods, rules and regulations, safety and technical control of operation.

Commercial Department : Commercial policy, details of charges, revenue, accounts, co-ordination and publicity.

Rolling Stock and Motive Power Department : General consideration of problems concerning rolling stock, depots and workshops, motive power and rolling stock, construction programmes, allocation of rolling stock fleet.

Structures Department : General policy on permanent way equipment. Signalling. Electrification, building, civil construction.

The other sections of the General Management are :

— General Research : Working out of overall plans, research and work covering the whole undertaking. Costs. Statistic. Publications.

— Budget : Working out of the annual budget of the S.N.C.F.

The Directors in the General Management have no authority except for that delegated by the General Manager.

There are also the following executive, research and control sections under the orders of the General Management:

Supplies Department;

Electric Power Department;

Marine Equipment;

Pension Funds;

Reserve Funds;

Fuel Allocation;

Special research sections on rolling stock and motive power;

Experimenting and scientific research sections and laboratories;

Purchasing Control;

Works Control;

Revenue accounting and control;

Wagon movement Office.

#### *Greece.*

The General Management of the Hellenic State Railways is assisted by the following Central Departments:

Administrative Department (Secretariat, Staff, Statistics); Health Department; Litigation Department; Technical Training Department; Operating Management (technical and commercial operating rules, station equipment, timetables, traffic control, rolling stock allocation control, examination of charges problems, policy towards competitors, etc.); Permanent Way and Building Management (technical study of permanent way and civil construction matters, fixed equipment, electrical and telephonic equipment, control of maintenance of equipment, etc.); Motive Power and Rolling Stock Management (technical study of and regulations concerning rolling stock, fuel, rolling stock maintenance programme, acquisition and rebuilding of rolling stock, etc.); Supplies Department; Finance Directorate and General Accounting Department.

All these Departments are simply bodies for research and control and supervision of the outdoor departments which are

grouped under two Regional Managements.

The Managers and Heads of these Central Departments are the General Manager's and Deputy General Manager's advisers. All orders and provisions emanating from these Departments must carry the General Manager's and Deputy General Manager's signature.

#### *Italy (F.S.).*

The General Management of the Italian State Railways consists of eight Central Departments:

Operating Department (train movement, timetables, use of rolling stock); Traffic and Commercial Department (charges, carriage on contract, revenue control, steps to meet competition); Rolling Stock and Motive Power Department (use of motive power, operation of locomotives, construction and repair of rolling stock, train ferries); Works and Building Department (construction of fixed equipment and building, electrification, safety and signalling apparatus, telecommunications); Staff and General Department; Supplies Department; Finance Department (financial control, budget); Health Department.

Each of these Central Departments is governed by a Departmental Head. Their functions consist not merely of policy making, co-ordination and regulation; they also have executive functions in the sense that they deal, at a system-wide level, with the type of problem which arises locally.

The powers of the Central Departmental Heads are determined by the Minister of Transport; these Managers are responsible for their administrative actions to the Minister and to the General Manager, under whom they are placed in the chain of command.

There are also special sections responsible directly to the General Manager and attached, for administrative purposes, to the Staff and General Department. In particular, there is the Experimental Institute (Laboratories) and the Central Mobilisation Office.

*Netherlands.*

The General Management of the Dutch Railways is assisted by seven Central Departments, whose functions may be briefly defined as follows :

General Department (Staff, Welfare, Medical department, legal affairs);

Operating Department (Operation of freight rolling stock, rostering of locomotives and passenger rolling stock, timetables);

Way and Works Department (Permanent Way, overhead works, level crossings, civil construction, various workshops concerned with fixed equipment);

Rolling Stock and Workshops (Renewal and repair of motive power, electrification, traction sub-stations, central workshops, lighting);

Signalling (Signalling equipment and workshops, telecommunications);

Economic Affairs Department (Charges, carriage on contract, litigation, research into transport needs, publicity and information, town planning developments);

Finance and Accounts Department (Financial management, revenue accounting, and control, staff administration, statistics, budgets, costs).

The Managers of these Central Departments have powers specially delegated to them by the General Management.

There are also sections of the Central Management which are neither technically nor administratively attached to the Central Departments. They are

- the Economic Efficiency Office (scrutiny of financial commitments and cost accounting);

- the Purchasing and Stores Office;

- the Railway Police;

- the technical and economic research and experimental office (for the co-ordination of technical research and experiment and the relation of it to the economic questions);

— the Operating Department, which is, in effect, an intermediate supervisory body between the General Management and the basic units, and which we shall discuss later.

*Portugal.*

The General Management of the Portuguese Railways has at its command three Departments (Management Secretariat, Medical Department and Litigation) and five Divisions (Supplies, Commercial, Operating, Rolling Stock and Motive Power, Way and Works).

In general the Divisions have no executive functions, apart from those that cannot be delegated to lower supervisory bodies.

The Divisional Heads act on the orders of the General Manager and wield in this manner powers which are specially delegated to them.

*Switzerland (C.F.F.).*

In the Swiss Federal Railways, there are 14 Central Departments. Apart from the General Secretariat they include — Financial Control and General Accounting, the General Cashiers and Deeds Department, the Staff Division, the Medical Division, the Passenger Commercial Department, the Goods Commercial Department, Traffic Control, Treasurer, Works Division, Operating Division, Motive Power and Workshops Division, Generating Stations Division.

The general powers of the divisions are fixed by the statutory order; they amount for the most part to those functions which can only be centrally run, but they are sometimes executive functions in the true sense.

The functions of General Managers and Divisional Heads respectively are fixed by the order referred to. Thus the delegation of powers in the strict sense does not occur. The Divisional Heads control, in the name of the General Management, those matters which are within their province.

## IV.

## A. — Supervisory body directly subordinate to the Central Body.

**INTERMEDIATE SUPERVISORY BODIES BETWEEN THE CENTRAL ADMINISTRATION AND THE BASIC UNITS.**

The number of these bodies varies between the different systems and sometimes even within a single system between the different Departments. In the same way their nomenclature differs from country to country. This can lead to confusion when terms such as Management and District are mixed up, since they are not applied to bodies at the same level of the hierarchy in all Administrations. For this reason, it would appear useful to set out the following diagrammatic table before going on to the details regional organization of each of the Administrations examined.

*French West Africa.*

At the head of each region there is a Regional Manager. Each region includes the following Departments : Movement and Traffic, Rolling Stock and Motive Power, Permanent Way and Building, Administrative Division, Accounts, General Supplies, Medical Department, Special Police.

In certain Departments which are of lesser importance the Department Heads have direct control of the Heads of the basic units. When the department is important enough to require it, an intermediate supervisory body is formed.

The organization of departments which are internal to a Region corresponds fairly exactly to the grouping of the central

	First Intermediate Supervisory Body	Second Intermediate Supervisory Body
<i>West Africa</i> .....	Region with three Departments Movement and Traffic Permanent Way & Building Rolling Stock and Motive Power	« Movement and traffic » section (in some cases) « Permanent Way & Building » (in some cases) Nil
<i>Algeria</i> .....	Operating District Rolling Stock & Motive Power District Permanent Way and Building District	Operating Inspectorate Rolling Stock & Motive Power Supervisory Section Permanent Way and Building Section
<i>Federal Germany</i> .....	Regional Management (same Departments as Central Departments)	Operating District Traffic District Rolling Stock and Motive Power District New Works District (in some cases)
<i>Austria</i> .....	Regional Management with four Departments : Administration & Accounts Operating Works Motive Power and Workshops	Nil Nil Permanent Way Inspectorate Motive Power Inspectorate

	First intermediate Supervisory Body	Second intermediate Supervisory Body
<i>Belgium (S.N.C.B.) . . . .</i>	Regional group with 4 technical subdivisions:  Operating Rolling Stock Permanent Way Electrical, Signalling	Nil Workshop Group Permanent Way District Electrical and signalling District
<i>Belgium (S.N.C.V.) . . . .</i>	Regional group	Nil
<i>Spain . . . . .</i>	Zone with four Departments  Operating Commercial Rolling Stock & Motive Power Permanent Way & Works, Electrical	Operating Inspectorate Traffic Inspectorate Ticket collection Inspectorate Co-ordination Inspectorate Claims Inspectorate Section (for movable stock only)
<i>France . . . . .</i>	Region with three Departments  Operating Rolling Stock & Motive Power Permanent Way & Building	Permanent Way Section  Operating District Rolling Stock & Motive Power District Permanent Way & Building District
<i>Greece . . . . .</i>	Region with three Departments  Operation Permanent Way Motive Power	Operating Inspectorate Permanent Way Section Nil
<i>Italy (F.S.) . . . . .</i>	Division, split into sections	Nil
<i>Netherlands . . . . .</i>	Operating Department (Central Office)	Operating Inspectorate with four executives Movement Permanent Way Motive Power Signalling.
<i>Portugal . . . . .</i>	Commercial & Operating Division Permanent Way & Works Division Rolling Stock & Motive Power Division	Movement Section, Accounts Section Permanent Way Section  Nil
<i>Switzerland (C.F.F.) . . . .</i>	District with 4 divisions :  Administrative Works Operating Motive Power	Sections (in some cases)

departments of the Group Management, except that the functions of the Rolling Stock and Motive Power and Permanent Way and Building Departments are carried out by the Technical Department of the Group Management so far as works and planning are concerned and by the Supplies Department so far as the purchasing programmes are concerned.

#### *Federal Germany.*

Between the H.V.B., the central management body and the basic units there are, firstly, the Regional Managements.

The whole of the D.B. system is, in fact, divided into 16 Regional Managements, each one run by a Chairman. Each Management directs operations in its division, in so far as the administrative work in question does not overlap the H.V.B. or the Central Departments.

The Chairman of each Management directs the whole of his area and does not simply fulfil the role of a co-ordinator of the various branches of the service. However, there are separate management bodies for the Workshops Department and each of these management bodies covers the area of several of the ordinary Managements.

The Heads of the various branches of management fulfil, under the responsibility of the Chairman, the specialized functions which are entrusted to them. They issue orders as the representatives of the Managing Committee. The Departmental Heads of the H.V.B. thus have no authority over the Divisional managers.

It should be noted that the division of the various Departments in the Managements is almost the same as that in use in the H.V.B.

#### *Austria.*

Between the General Management and the local units, there are « Offices » and « Departments ». The difference between « Offices » and « Departments » is as follows : an Office specializes in a single activity, whereas a « Department » covers

several activities: an « Office » covers the whole of the federal territory whilst a « Department » is limited to its own area.

A point that we shall come to later and which is worthy of remark is that certain local units report direct to the General Management.

An office is run by a Manager and a Department by a Chairman.

Technically, the Offices report to the General Management or to a Central Department (for example, the Central Water Power Office and the Electrification Office, which are branches of the electrical department; the Staff Office, a branch of the General Secretariat; the Wagon Office; the Revenue Office; the Claims Office, a branch of the Commercial Department). In relation to the local units, these are on the same level as the Regional Managements.

The Regional Managements report directly to the General Management. They include the following Departments : Administration and Accounts, Works, Motive Power and Workshops, Operating. The Management Chairmen are charged with supervising the co-ordination of the various Departments.

#### *Belgium (S.N.C.B.).*

In the S.N.C.B. the intermediate body between Management and the local units is the regional « group » (eight in number over the whole system).

At the head of each group is a senior official, the group Chief. His task is essentially to co-ordinate and supervise.

The various subdivisions of the group — Operating, Rolling Stock, Permanent Way or Electrical, and Signalling — report directly to the central supervisory body, without reference to the Group Head. It should be noted that certain functions bypass the regional supervisory body. In particular, the main workshops are responsible to the Central supervisory body.

Generally speaking, the regional body has the same constituent parts as the central

body, although at a lower level; executive and supervisory duties take precedence over management and the issue of general rules.

The Operating subdivision corresponds to the Operating Management and the Commercial Department in the central body. But the Commercial Department has, in addition, another regional organization at its command — the commercial agents, who are specially concerned with watching over goods traffic and contact with customers. The geographical areas of the agencies are not always the same as those of the groups.

In the regional body, the Finance Department is represented by a regional accounts office and the Staff Department by a staff affairs and welfare office on the one hand and a regional medical centre on the other.

#### *Belgium (S.N.C.V.).*

In the S.N.C.V., as in the S.N.C.B., there are « groups » which take part in the operation of the system. The Heads of these groups are placed under the immediate authority of the General Manager, certain of whose powers in this respect may be delegated to the Departmental Managers and Heads in the Central Administration.

In general, the organization of the groups differs from that of the central body in that their activities are of a strictly technical character.

#### *Spain.*

The R.E.N.F.E. territory is divided into zones, each one in the charge of a Manager.

Each zone comprises four departments : Operating and Commercial, Rolling Stock and Motive Power, Permanent Way and Works, and Electrical. But certain departments which are, geographically speaking, in zonal territory, none the less report to the appropriate Central Departments : General Rolling Stock and Motive Power Workshops, General Workshops for fixed Permanent Way equipment, Main and subsidiary stores, Regional supplies offices, the Regional Fuel Department organization,

the Health service and inspectorate, the Treasurer, Forestry operations and Regional cashiers.

The Zonal Managers come directly under the orders of the particular Managements to which they are answerable for the proper working of their Departments. Normally it is they that deal with the Departmental Chiefs. In special circumstances, the staffs of Headquarters Departments may deal with the Zonal Departments on day to day matters. The position of the Zonal Managers in the organization is that of Deputy Chief of a headquarters Department and the position of a Zonal Departmental Chief is analogous to that of a central departmental chief.

#### *France (S.N.C.F.).*

The S.N.C.F. is divided into six Regions each run by a Regional Manager.

The Regional Managers are entrusted by the General Management with the management of railway operations in their Regional areas within the framework of the orders, instructions and directives that they receive from the General Management.

The Regional Manager has full powers within his area, apart from those entrusted to specialized bodies reporting directly to the General Management.

The Departmental Heads of the General Management have no authority over Regional Managers except as representatives of the General Manager on general questions.

Each Regional Manager is assisted by three Departmental Heads : Operating, Rolling Stock and Motive Power, Permanent Way and Buildings. He also has a Chief Engineer, concerned with welfare (').

The division of responsibility for these various Regional Departments does not correspond exactly to that of the different Departments or sections of the General Management.

(') The Mediterranean Region is subject to a special organization.

The Operating Department generally includes : the General Section (Secretariat, Accounting, Staff, General Superintendent), the Movement Section (Rules and regulations, Timetables, arrangements for carriage, allocation of Rolling Stock), the Commercial Section (traffic, co-ordination, litigation, refunds, Accounting controls), the Planning Section (safety installations and station working).

The Rolling Stock and Motive Power Department : the General Section (Staff, Accounts, Supplies), the Motive Power section (Movement and maintenance of locomotives and the electrical section), the Rolling Stock section (motored and trailing rolling stock).

The Permanent Way and Buildings Department : the General Section (Staff, Accounts, Estates), the Maintenance Section (Maintenance and inspection, Works and Supplies, Stores) the Planning Section (Building and civil construction, signalling, electrical installations).

#### *Greece (C.E.H.).*

The system is split between two Regional Managements. Each Region is run by a Manager reporting directly to the General Manager. The Central Departmental Managers thus have no direct authority over the Regional Managers.

Each Management includes, basically, an Operating Department, a Permanent Way maintenance Department, and a Motive Power Department. The arrangement of these Department corresponds to a large extent to the arrangement of the Central Departments.

#### *Italy (F.S.).*

The intermediate supervisory bodies between the General Management and the local units are the districts. These are divided into sections, one for each branch of operation under Sectional Heads who follow the general instructions of the District Head, but are responsible on the technical side to the appropriate technical Department.

The Central Department Heads have no direct authority over the District Heads. These report, in actual practice, to the General Manager.

The Districts are subdivided into offices. Their organization corresponds, on a reduced scale, to that of the General Management, apart from the one case of the Works and Building Department. Here, the corresponding regional bodies are the Works Sections and the Electrical and Signalling Equipment Offices.

#### *Netherlands.*

Since the system is of limited extent, the intermediate supervisory body between the General Management and the local units is the Operating Department, which consists of a Central Office (see above) and eight Inspectorates.

Each Operating Inspectorate is run by four inspectors : one for Movement, one for Permanent Way, one for Motive Power and one for Signalling.

The inspectors report directly to the Head of the Operating Department. The Heads of the Central Departments have no authority over the inspectors.

#### *Portugal.*

The regional Departments have neither Managers nor Chairmen. The areas are directly under the orders of the appropriate Departments.

Within each area the arrangement of Departments corresponds to the arrangement of the Central Departments.

#### *Switzerland (C.F.F.).*

The intermediate supervisory body between the general management and the local units is the district management.

However, there is no intermediate body between the motive power and workshops department on the one hand and the workshops on the other. The same applies to generating stations.

Each of the three districts is managed by a district manager reporting directly to the General Management, not to the Central

Departments. Each district manager has four sections under his command : the administrative section, the works section, the operating section and the motive power section.

The last three sections correspond to the similar sections of the General Management. The first one works with the staff, litigation, medical and general management departments.

The sections of the general management and the districts correspond directly to each other in spheres of action.

The sectional heads must submit important questions to the Head of the relevant Department or to their district manager, either for information or to obtain a decision.

#### B. — Other intermediate supervisory bodies.

##### *French West Africa.*

There is no second intermediate supervisory body, except that of the three Departments of the Dakar-Niger Region : Movement and Traffic, Permanent Way and Buildings, Rolling Stock and Motive Power. In this region, the first two have each of them a third supervisory body.

##### *Algeria.*

The Operating Districts are made up of Inspection sections, run by Inspectors.

The Rolling Stock and Motive Power Districts consist on the one hand of units including depots and their attached workshops as well as the supervisory sections belonging to these units and, on the other hand, rolling stock units (workshops) minor maintenance units and travelling maintenance units.

The Permanent Way districts are subdivided into sections.

##### *Federal Germany.*

In each management's area, Operating Districts, Traffic Districts, and Rolling

Stock and Motive Power Districts, are established. When major works of construction or reconstruction are undertaken, « New Works » districts are set up.

The local units are directly under the command of the Operating Districts. They comprise :

a) movement sections (stations and halts);

b) traffic sections (forwarding, booking offices and station cashiers);

c) Permanent Way and Building Sections (permanent way districts, buildings districts, signalling districts, telecommunications and also engineer's trains, permanent way works, crossing works, permanent way equipment works, signalling workshops, telecommunications workshops);

d) Rolling Stock and Motive Power Sections (depots, maintenance, road transport garages, overhead electrical equipment districts, railway generating stations, high tension current districts).

The units referred to in a) and c) above are normally subordinate to Operating Districts while those set out in d) are subordinate to Rolling Stock and Motive Power Districts and those referred to in b) to Traffic Districts.

##### *Austria.*

Stations, Motive Power Inspectorates and Permanent Way Inspectorates are directly responsible to the Regional Managements. In addition, the following are responsible to the General Management : the Signalling Inspectorates, the Telecommunications Inspectorates, the Major Workshops, Inspectorates of the Electrical Department and Offices, the electric cable, Power Stations and Stores Inspectorates.

##### *Belgium (S.N.C.B.).*

In the Operating Department, there are no intermediate bodies between the regional management and the stations. In the sphere of station working, there are, however, inspectors in charge of work of this kind.

In the Rolling Stock Department, the workshops are grouped in administrative units.

In the Permanent Way Department, the regional group is subdivided into districts (averaging four in number) and each comprising two or three sections. There are also districts in the Electrical and Signalling Department.

#### *Belgium (S.N.C.V.).*

There are virtually no intermediate bodies under the groups, since the latter are not sufficiently important to warrant them.

#### *Spain.*

There are Divisions or Inspectorates under each Zonal Department : Divisional Operating Inspectorates, Traffic Inspectorates, Checking, co-ordination and claims Inspectorates for the « Operating and Commercial » Department, Depots, Workshops, and Rolling Stock Divisions for the « Rolling Stock and Motive Power » Department, Permanent Way Sections, Electrical Divisions and Electrification Divisions for the « Permanent Way and Works » Department. The permanent way divisions are divided into districts and these in turn are, divided into sections.

#### *France.*

Each Region of the S.N.C.F. is divided into districts : Operating, Rolling Stock and Motive Power, Permanent Way and Buildings. The functions of these different districts correspond to those of the regional Departments to which they are responsible. The District Chief is responsible for the operating of that department within the territory of his district and on the basis of the orders, instructions and directives which he receives from the Regional Management.

The Operating Districts consist of Movement Sections and Traffic Sections, the Motive Power Districts consist of depots, the Rolling Stock Districts consist of main workshops and maintenance depots, the

Permanent Way and Buildings Districts consist of Sections, themselves divided first into areas and then into sub areas.

#### *Greece.*

Under each Management, the Permanent Way Sections and maintenance services are responsible directly to the Permanent Way Department, Telephone and Telegraph works to the Fixed Equipment Department, locomotive depots to the Motive Power Department, the Operating Inspectorates to the Operating Department.

The Permanent Way sections are themselves divided into districts.

#### *Italy.*

The local units are directly responsible to the regional districts.

#### *Netherlands.*

There is no intermediate body between the Operating Inspectorates and the local units.

#### *Portugal.*

Those Districts, which are common to the Operating and Commercial Departments, have dependent upon them Movement Sections and Accounts Sections. The Districts of the Permanent Way and Works Department have Sections and the Districts of the Rolling Stock and Motive Power Department have depots.

Under the Regional Management, respectively to these divisions, are dependent : on the one hand, the maintenance sections, which are also divided into districts; on the other hand, the establishments.

## V.

### GEOGRAPHICAL ORGANIZATION.

The following table gives statistical information on the numbers and average importance of the Regions in each Administration. The term « Region » is here

## REGIONAL SUPERVISORY BODY.

	Number of Regions	Average length of line in each Region	Average length of track in each Region	Average number of staff in each Region	Notes
<i>French West Africa</i> ....	4	938 km	1 076 km	3 483	
<i>Algeria</i> .....	—	—	—	—	(No Regions only Districts).
<i>Federal Germany</i> .....	16	1 900 km	—	32 000	
<i>Austria</i> .....	4	1 500 km	—	14 500	The Vienna Region has 2 895 km and a staff of 25 000.
<i>Belgium</i> (S.N.C.B.) .....	8	—	628 km	9 285	
<i>Belgium</i> (S.N.C.V.) .....	7	from 300 to 800 km 1 870 km	—	from 65 to 2 200 16 810	
<i>Spain</i> .....	7	1 870 km	2 600 km		
<i>France</i> .....	6	6 870 km	14 100 km	70 860	
<i>Greece</i> (State) .....	2	623 km	770 km	3 612	
<i>Italy</i> (F.S.) .....	14	1 187 km	2 015 km	11 508	Not includ- ing the Ter- ritory of Trieste, 106 km of line and a staff of 2 789.
<i>Netherlands</i> .....	8	400 km	875 km	3 000	
<i>Portugal</i> :					
— Operating & Commer- cial Districts .....	7	510 km		1 405	
— Rolling Stock & Mot- ive Power Districts	5	715 km		1 953	
— Permanent Way & Works Districts ....	5	715 km		951	
<i>Switzerland</i> (C.F.F.) ....	3	990 km	2 070 km.	10 065	

applied to the supervisory body directly under the central body.

We shall undertake, in what follows, to analyse in the case of each Administration, the principles which have led to the fixing of this particular number and this average level of importance. We shall also specify how this geographical division of the country into Regions has been effected.

#### *French West Africa.*

The French West African Railway Administration includes four regions of unequal importance. Each region is formed by the railways built within the whole of one or several of the territories of the French West African General Federal Government. This is, indeed, the only rational solution, since the lines in each region form a distinct and homogeneous unit, without rail links with the lines in the other regions.

#### *Algeria.*

(It will be recalled that the Algerian Railways have no regions in the strict sense.)

#### *Federal Germany.*

The D.B. system is divided into 16 Managements. On the average they have 1 900 km of line and a staff of 32 000. They are equivalent to 11 Operating Districts, 5 Rolling Stock and Motive Power Districts, 5 Traffic Districts and 1 New Works District.

For historical reasons, the Managements differ greatly in importance : the length of line varies from 986 to 312 km and the number of staff from 8 500 to 48 000.

The delineation of the areas is basically the result of the political and geographical structure of the country.

It may be recalled that there are Workshop Managements; in fact five of the sixteen Managements fulfil this role.

The D.B. system includes 173 Operating Districts, 79 Rolling Stock and Motive

Power Districts, 74 Traffic Districts and 30 New Works Districts. The delineation of the Districts is influenced by the economic structure of the country.

#### *Austria.*

In Austria, the system is divided into 4 Managements, of historical origin. The Austrian Federal Railways Administration is undertaking a re-organization of these Managements. It is thought, in effect, that both the operation and the administration of a 6 000 km system can be centralized; the aim of the re-organization that is contemplated is to reduce the functions of the Managements, leaving them only those control and executive powers which are strictly necessary.

At present, the length of line per Management varies from 518 to 2 895 km, and the staff from 7 000 to 25 000 persons.

#### *Belgium (S.N.C.B.).*

The S.N.C.B. has divided the system into « groups ». The conception of groups formed by the axial lines, centred on Brussels and with branches attached to them persisted down to the end of 1940, but was not entirely satisfactory. At that time, a central group was set up to co-ordinate the movement of the various traffic flows which pass mainly through the central part of the country.

After the war, the division of the system was based on one group per province. However, the province of Hainaut has been divided into two separate groups, the headquarters of one being in the provincial capital and the other at Charleroi, an important town in a highly industrialised area. Since the beginning of 1952, the Arlon and Bruges groups have been wound up and attached to those of Namur and Ghent respectively.

#### *Belgium (S.N.C.V.).*

The system is divided into 7 operating groups, the length of line varying from 300 to 800 km. Geographical dispersion and

the position of the principal centres have played a preponderant part in fixing the boundaries of the groups. These are therefore based on the economic rather than the political structure of the country.

#### *Spain.*

In Spain, the division of the system into 7 parts called « zones » goes back to the amalgamation of the former Companies. The number and relative importance of these Zones has been retained since then, because their average size is such that there is only one supervisory body between the General Management and the local Divisions; each of these zones has a length of about 2 000 km and has a communication's system which allows of easy communication with the zonal headquarters.

In the geographical delineation of the zones, the first consideration has been the shape of the system itself, the existence of railway centres and the distribution of traffic. So far as possible, the radial structure of the system has been retained.

#### *France.*

The S.N.C.F. system is divided into 6 Regions : East, North, West, South West, South East and Mediterranean. The boundaries of these Regions (\*) with a few alterations, more or less follow those of the old systems. These virtually formed radial lines, centred on Paris and leading towards the frontiers of the country.

The Mediterranean Region was formed in 1947 with the aim of effecting geographical decentralisation. This measure of decentralisation was aimed partly at speeding up the executive process in a geographical area that was far removed from Paris, the headquarters of the General Management and the other Regional Managements, and partly at trying out expe-

(\*) Except, of course, for the boundaries of the Mediterranean Region, which was formed by abstraction from the former South East and South West Regions.

rimentally a new form of organization of the Regional Departments which might result in a reduction of the staff of the regional management body. In fact, it does not seem that the Mediterranean Region experiment is suitable for extension to the whole of the S.N.C.F. Although it permits functional regrouping of a kind which would be worth extending, in so far as its application to wider areas was not counterbalanced by serious difficulties, the experiment has led to an increase in the general expenditure of the S.N.C.F.

#### *Greece.*

The existence of the major administrative centres of Athens and Salonica has led the number of regions of the C.E.H. to be fixed at two.

#### *Italy (F.S.).*

In Italy, the State Railways are divided into districts. The geographical nature of Italy and the extended nature of the railway system have led to a departure from the principle of geographical divisions, radiating from the headquarters of the central departments. The system of « district » organization allows of effective control and supervision even of the most distant lines which a centralised system would have been liable to neglect in favour of lines that were closer, geographically, to the regional headquarters.

The arrangement of districts has been made essentially on the basis of geographical and economic considerations; as a result, the districts vary greatly in importance. The largest is that of Turin (1 937 km of line and 13 917 staff) and the smallest that of Cagliari (417 km of line and 1 828 staff).

#### *Netherlands.*

The system includes 8 Operating Inspectorates, the number being determined by the volume of traffic to be controlled. They are based on the economic structure of the country.

*Portugal.*

The system is not divided into regions but directly into Divisions, which vary from Department to Department (7 for Operating, 5 for Rolling Stock and Motive Power, 5 for Permanent Way and Works).

The actual placing of the boundaries of the Divisions is derived in essence from the grouping of the former concessions. Its aim is to facilitate the process of control. The system intends to amalgamate these boundaries, in the geographical sense.

*Switzerland (C.F.F.).*

In Switzerland, not only geographical, but also historical and political principles have shaped the various regions and determined their relative size.

When the former companies were nationalized, their headquarters were situated in various places. For example, that of the Gothard Company was at Lucerne. These places became the centres of the newly established « districts ». To start with, there were five districts. These were reduced to three after the first World War. But an Operating Inspectorate and the Central Treasurers Department remained at Basle, a former district headquarters and the central freight traffic control department remained at St. Gall — also a former district headquarters.

Moreover, since Berne was both the headquarters of the General Management and, at the same time, that of the Confederation's central administration, railway administration had to be situated elsewhere in order to conform to the decentralization which is a part of the federal structure of the Swiss Confederation. In the end, it has been found that the relative importance of the different regions has tended to equalise itself.

\* \* \*

## VI.

**RAILWAY ADMINISTRATION'S COMMENTS ON THEIR OWN ORGANIZATIONS.**
*French West Africa.*

The geographical shape of the French West African system and the scattered positions of the lines require extensive decentralisation; none the less, certain matters must be centralised : financial matters, staff regulation matters, the budget and, as a result of these, staff statistics, general programmes for the acquisition of equipment and for the extension and modernisation of the system.

The tendency is to reduce as far as possible, the number of superimposed bodies and to promote supervision by means of inspectors.

*Algeria.*

The three Departments of the Algerian Railway System (Operation, Rolling Stock and Motive Power, Permanent Way) are divided into districts with their headquarters respectively at Algiers, Oran and Constantine. Each Department has a District Chief in charge, so that, within the territorial area of each district, responsibilities fall on different Chiefs for the different Departments. However, this position has never caused any difficulty and the divisions adopted correspond to the political and economic division of Algeria into three provinces centred on Algiers, Oran and Constantine.

*Federal Germany.*

The concentration of responsibility in one man at regional level has the advantage, according to the D.B., that the man responsible keeps a more careful watch on all the activities involved. He does not favour one branch of the service to the detriment of the others. He exceeds the bounds of mere co-ordination and brings into harmony the divergent tendencies of the various branches. But, of course, it is as well to beware lest specialization is neglected in the decisions that are taken. With this in mind, the man in charge is given every opportunity to consult the specialist groups.

By contrast, an organization in which responsibility is concentrated on a small group of the chiefs of the various divisions or specialist groups leads to a lack of co-operation and to disregard to the general interest.

None the less, a certain degree of specialisation may offer the advantage of more efficient working in the various branches; this may be especially the case at the local level. For this reason, where the amount of traffic and importance of the work undertaken makes it necessary at this level, the D.B. has carried out a division of responsibility between the specialised departments. If inter-departmental co-operation at the local level raises difficulties, these are resolved by the Districts who can, as required, appeal to the Managements for a decision.

In forming its scheme or organization, the D.B. has always followed the principle of extensively decentralising functions and powers. The basis of the work done thus remains in the local units and the powers entrusted to them are as wide as possible. The directing bodies may only intervene to establish general policy and give overall directions. As a result, the H.V.B. or the Managements are only concerned with matters that cannot be dealt with by lower authorities. This does not mean that no individual difficulties are referred to the central departments : such a concentration in many cases permits a better utilization of staff and a more rational organization of business.

#### *Austria.*

The Austrian Railway Administration holds that the concentration of executive power within a certain area in the hands of one man offers the advantage that the interests of the different Departments can be quickly reconciled.

The disadvantage of this system lies in the possibility that the single manager may be overworked. Where power is allotted between several managers, this need not be feared.

Either system, however, may give good or bad results, according to the ability of the managers themselves.

Up to the present, Austrian Railway practice has been to use individual managers. They are satisfied with the system and do not propose to change it.

#### *Belgium (S.N.C.B.).*

In the opinion of the S.N.C.B., an organization by which all responsibility in a given area is entrusted to a single chief, is advantageous because of more effective co-ordination between the different departments.

The difficulty, however, lies in finding a sufficient number of chiefs who possess in requisite measure, both the widespread experience and the highly developed qualities needed to apply the general policy decreed by the central authority.

If such regional chiefs of this sort are lacking, the result is disunity in operation, a lack of co-ordination, discontent on the part of staff who receive different treatment in different regions, and variation in the service given to customers.

Another disadvantage arises from the need to reduce the size of the zone. If this were not done, it would be necessary to appoint specialist deputies to assist the chief.

In an organisation, in which responsibility within a given area is entrusted to a different chief for each Department, as many chiefs are required as there are types of work. Difficulties similar to those mentioned above recur. There is one extenuating circumstance, that the chiefs to be appointed need not have such wide experience, but also an added difficulty in that co-ordination between chiefs in a particular region and also between different regions becomes more awkward. A corrective may be found in giving to the regional chiefs instructions which are precise enough to ensure that, in particular respects, all regions work in the same way, rather than general directions open to liberal interpretation.

A form of organization in which group chiefs were responsible for all work within a given area was tried out by the S.N.C.B. from 1942 to 1947. Since then, this form of organization has been abandoned. The central authority became aware that, in spite of steps taken to promote efficient co-ordination, the general directives were carried out in very varied ways by the group chiefs. This hindered that rationalization and standardisation of methods of work without which the operation of so dense a network as the Belgian system would be inconceivable.

At present, general policy instructions are drawn up by the specialized Departments of the central body. The regional body takes no part in drafting them.

The S.N.C.B. considers that this organization has the following advantages :

— It removes the danger of running counter to general policy, the risk of passing on orders incorrectly, and the risk that orders may be wrongly interpreted by the local body.

— Control by the regional body is simplified, since general directives are replaced by detailed orders which sometimes take the form of specific instructions.

— The local body can be sure that, if inconsistencies or imperfections arise when orders are carried out, its comments will receive the attention of the regional body, since it is the duty of the latter to inform the central authority.

— The central body can examine potential improvements to which the local body has drawn the attention of the regional body. Improvements effected in this way can be passed on to all local sections.

One objection, which might be raised against this form of organization, is that the position of the regional chief is somewhat passive. This objection may be dismissed. The Central Management in fact requires the Regional Chief to show a very high degree of initiative in pursuit of the aims set before him by the Central Management. In addition, the difficulties result-

ing from a lack of co-ordination between the various specialized departments at regional level are mitigated by the fact that one of the regional chiefs is charged with the duty of maintaining the necessary liaison.

#### *Belgium (S.N.C.V.).*

The S.N.C.V. considers that an organization with a single chief in a given area, implies a « chain of command » type of organization. Its basic advantages are simplicity, ease of control and the maintenance of discipline. On the other hand, such an organization is distinguished by slowness, lack of specialization, difficulties of co-ordination and the dangers of parochialism.

On the other hand, the basic advantages of a system of divided responsibility are a better division of work, greater adaptability and wider scope for initiative, fore-stalling any excessive power in the hands of a single chief. But there are grounds for fearing a lack of control of operations, a lack of discipline and also insufficient allocation of responsibility for certain functions.

#### *Spain.*

The R.E.N.F.E. Administration holds that it is difficult to draw conclusions which can be applied to all systems from generalized ideas put forward on the subject of organization. This is because of the many special factors which influence the position of each system. Keeping to the specific case of the Spanish system, the R.E.N.F.E. Administration emphasises that the seven regional zones were set up with the object of decentralizing the executive process and the control and supervision of the actual work. At the same time a chief was placed at the head of each zone, who was endowed with initiative and the power to issue orders and could thus manage the various departments in his zone with the greatest possible efficiency and by direct contact with the staff. The results so far achieved give grounds for considering this step to be successful.

*France (S.N.C.F.).*

The S.N.C.F. took over from the former French railway systems, each of which had its own characteristics and individuality. Unity of control has been achieved by entrusting the rights and responsibilities involved in the running of so large an undertaking to a General Manager who is controlled and instructed on general policy by the Administrative Board.

The formation of a national system necessarily entailed the disappearance of regional peculiarities, so that unification of technical practice might follow upon unification of management. Besides, the S.N.C.F. had set up Central Departments which were to form the General Managers « General Staff ». In order to unify practice quickly, certain executive powers had to be entrusted to these Departments. So, for a time, they took on a guise of an intermediate supervisory body between the General Management and the Regions. In this way, the Central Departments succeeded in establishing a new spirit in all branches of railway work and have achieved a remarkable unity. Then it became possible to incorporate these Departments in the General Management, which has now resumed its role of general staff. Its functional activities, allied to its general tasks of organization, direction and supervision, are divided out amongst the various Managements which centre on the General Manager and his Deputies.

The Regional Departments, which formerly undertook entire responsibility for the railways were over large, after inauguration, since certain of their important functions were transferred to the Central Departments, without these latter taking over the staff concerned.

Then the S.N.C.F. applied itself to regrouping the Regional Departments and the Regional Managements. At the same time its policy was to reduce and to concentrate these Departments. Still pursuing the principle of unified control, the same basis was adopted as for the General Ma-

nagement and the Central Departments. A single team was formed, consisting of the three Heads of the Operating, Rolling Stock and Motive Power, Permanent Way and Buildings Departments, together with the Regional Manager who thus became a real Regional Chief. The regional Departments became the Regional Manager's own Departments and, in fact, another intermediate supervisory body disappeared.

So far as Districts are concerned, the S.N.C.F. is not in favour of entrusting the management of all the departments within the District to a single executive. The principle of unified Districts may seem attractive but, to apply it generally, 40 to 60 men must be found who are outstanding enough, not only to have grasped thoroughly three different skills, but above all, each to be in direct control of a staff of twelve to fifteen thousand. It may be quite possible to train officials who combine sufficient ability in the spheres of each of the three Departments, but to make more than about ten subordinates report directly to a single supervisory body would be to ignore one of the elementary rules of organizing a chain of command: the number of Signal Box Inspectors, Commercial Inspectors, Area Inspectors, Main Station Inspectors and Permanent Way Section Inspectors would be well over twenty.

None the less, the S.N.C.F. is engaged, throughout the system, in regrouping certain functions as between Districts. In this it is managing to unify the headquarters and the boundaries of the different Departments. Thus it succeeds in giving the Districts a genuine identity, based on the team spirit, just as has been done for the higher bodies.

*Italy (F.S.).*

The system adopted by the Italian State Railways entrusts responsibility for the operation of the different departments in the regions (Districts) to the departmental heads. These answer directly for their actions to the appropriate Central Departmental Chiefs, from whom they also receive

all necessary orders. In principle, the tasks allotted to the highest level of authority in the Region (District Superintendent) are those of supervision and co-ordination.

This system offers an advantage in that complete standardization in similar activities can be obtained throughout the country as well as straightforward interpretation and prompt fulfillment of instructions given by the Central Department, without any delay being caused by filtering past the District Superintendent.

A disadvantage is liable to arise from the fact that matters which concern several Departments may be dealt with differently by different regional heads and operation will thus be unco-ordinated. This disadvantage is, in practice, countered by the co-ordination which the Central Departments undertake on projects of any importance which affect several departments at regional level in the same area. In addition, the watch kept by the District Superintendent helps to reduce the discrepancies which might appear in this way and in the last instance to direct the work of the different groups towards a goal which, both technically and economically, will assist the undertaking. It is in precisely this sphere that the high administrative tasks in the hands of the District Superintendent become evident. Relieved of matters of detail, he has to harmonise and encourage the executives in their work.

#### *Netherlands.*

The Netherlands Railway Administration considers that the organization in separate lines of responsibility of specialist activities is advantageous in that all the work and experience appropriate to a certain sphere are concentrated. At the same time, a disadvantage of this form of organization lies in the danger that specialists in different Departments may lose sight of the general picture of operation. Thus, co-ordinating measures are required, to keep down the number of decisions to be taken and the amount of business to be dealt with.

In the sphere of operating in the strict

sense, this disadvantage is overwhelming. For this reason, on 1st January, 1952, the Dutch Railway Administration has combined, in one Operating Department, the local Inspectorates which were formerly attached to the Movement, Permanent Way and Works and Motive Power and Signalling Departments respectively. The running of each Inspectorate was entrusted to a group of four Chief Inspectors. Having only brief experience of this system, the Dutch Railways cannot yet pronounce a final judgment on the subject.

#### *Portugal.*

Responsibility within a given area falls on different chiefs for different departments; the Portuguese Railway Administration considers that, in this way, responsibility is better defined.

#### *Switzerland (C.F.F.).*

The present organization of the Swiss Federal Railways Administration answers to the requirements of the shape of the system and of the political and geographical factors to be taken into account. The organisation works satisfactorily and, since it fulfills requirements, there is no need to alter it.

None the less, the administration's standing orders have recently undergone revision. In this connection, one of the main debates has been on the alternatives of centralizing or decentralizing functions. A compromise solution has been adhered to. But at the same time they have avoided introducing, and have prevented the growth of duplication of function between central departments on the one hand and district sections on the other.

\* \* \*

### SIMPLIFICATION AND RETRENCHMENT OF ADMINISTRATIONS.

We shall outline below the steps which certain Railway Administrations have taken recently or propose to take with the object of simplifying their organization and reducing their administrative staff. Such steps

include : centralization of departments with the object of increasing efficiency, amalgamation or regrouping of offices, revision of geographical areas entrusted to certain supervisory bodies, elimination of intermediate supervisory bodies, institution or elimination of specialized activities, devolution of authority, simplification of methods of administration and elimination of administrative duties.

#### *French West Africa.*

The Administration has the following measures in view : the elimination of the Section stage in the Permanent Way Department, the amalgamation at regional and district level of secretariats and staff offices, the mechanization and centralization of accounts and, in addition, a reduction in the number of stations and of motive power depots as a result of dieselisation.

#### *Federal Germany.*

The D.B. proposes to re-organize its administrative structure profoundly; it recognises that the measures proposed will require considerable time. Amongst these measures may be quoted : workshop re-organization; re-organization of the Railway Police; amalgamation of the two Central Movement Offices and two Central Technical Offices; the elimination of small Managements and the division of their work between the adjacent Managements; a reduction in the number of districts; a reduction in the number of depots and of permanent way districts, so that better use may be made of motive power and mechanical methods of track maintenance; the amalgamation of the Traffic Department and the stations and, in general, the investigation of administrative work at all levels with the aim of simplifying it.

#### *Austria.*

Since 1945, when the Austrian State Railways became the Austrian Railway Administration, important changes have been made, which have allowed of extensive simplification and savings in staff : the estab-

blishment of a General Management and the transformation of the old Managements into bodies with less extensive powers, the centralization of administrative work by setting up Central Offices, the changing of stations into block posts and halts, the re-organization of the General Management and the reduction of the number of sections from 49 to 34, the elimination of Departments and transfer of work to the Managements.

#### *Belgium (S.N.C.B.).*

The measures carried out by the S.N.C.B. may be summarized as follows :

- elimination, regrouping and amalgamation of local units (depots, workshops, laboratories, charges planning offices, accounts at the regional level);
- revision of the geographical area covered by certain supervisory bodies (elimination of the Arlon and Bruges groups);
- decentralization of powers on litigation;
- simplification of administrative methods (setting up of standards of administrative staff establishments in certain departments, initiation of a procedure for working out operating and works programmes, improvement of budgetary control, extension of type-writing, decrease of administrative work at minor stations by concentration at important stations or at regional level, concentration of supplies on a few important stations, elimination of unnecessary work, particularly in respect of statistics and printed matter, revision of distribution of orders, etc., publication of a booklet aimed at instructing technical staff who are undertaking administrative duties for the first time).

#### *Belgium (S.N.C.V.).*

In the case of the S.N.C.V. may be noted : the centralization of certain general services (printing and duplicating, stationery department, publication of orders, statistics, general safety department), the setting up of a Staff Management, the amal-

gamation of regional groups which have been reduced from 7 to 6, the institution of new activities (organization, aptitude testing and safety sections, etc.), standardization and unification of methods (classification, tickets, stores, titles of staff, census of rolling stock), elimination of unproductive administrative work (letter registration, stores inventories), work of organization section in many spheres.

#### *Spain.*

The creation of « zones » in R.E.N.F.E. is precisely what is required in the effort to simplify organization and reduce administrative staff. In addition, the R.E.N.F.E. is looking for substantial results from the development of a General Reconstruction Plan, at present in progress, which is based, in essence, on technical improvements (electrification, signalling, vacuum braking, water purification, improvement of motive power, etc.). Further, the R.E.N.F.E. has decided to plan for and gradually to effect a 10 per cent reduction in staff. Finally, this Administration has decided to set up an economic control organization which will report directly to the Management and will extend its activities throughout the whole system.

#### *France (S.N.C.F.).*

With the aim of simplifying its organization and effecting a saving in staff, the S.N.C.F. has first taken simple measures of rationalization : Searching review of staff in all Departments and units; Amalgamation of subdivisions within Regional Departments and elimination thereby of sections in these Departments; elimination and amalgamation of Districts (1 Operating District, 6 Rolling Stock and Motive Power Districts, 2 Permanent Way and Building Districts); Setting up of expenditure control, setting up of joint audit offices for several districts, extensive use of office machinery (centralization of station returns, control of wagon exchange, costs and statistics of carriage, commercial offices at large stations, etc.); simplification of opera-

tion of minor lines (use of agents under contract, simplification of accounts and operating rules, elimination of level crossings, simplification of signalling, etc.); improvement in methods of rolling stock maintenance (increases in distance run between inspections, strict control of time for repairs, reduction of indirect expenditure), setting up of central stations for collection and distribution of traffic, improvement of methods of carriage in use, etc.

In addition, the S.N.C.F. has set to work on measures of rationalization, which are connected with investment and which all have the effect of reducing staff : concentration of despatch of freight, extension of railcar services and Diesel traction, electrification of 720 km of line (effecting an economy of staff of 5 000), signalling and hydro-electric installations, re-arrangement of equipment when reconstruction is undertaken.

Besides this, 750 km of line have been closed to freight traffic in 5 years — mainly through the institution of railheads. Moreover, 1 100 km of line have been « neutralized » — that is to say, that all the traffic centres on the line continue to be served, but certain sections of track are closed, the service being run in branch form from each end.

The S.N.C.F. proposes to continue its efforts in the directions that have been outlined above.

#### *Netherlands.*

The organization of the undertaking was simplified on 1st January 1952, when the Inspectorates formerly attached to the Movement, Motive Power and Signalling Departments were amalgamated under a single Operating Department.

The creation of this Department will enable decentralization to be effected by extending the powers of the Chief Inspectors. This will permit staff to be reduced through the re-arrangement of Offices.

In addition, the research and experiment in the technical sphere were centralized, on

1st January, 1953, in the Research and Experiment Office.

*Italy (F.S.).*

The review of organization, the simplification of methods and the staff changes connected with them will all be considered with reference to the railways on the basis of a reform of the Public Administration, which will follow a law at present being drafted.

The railways will, first and foremost, try to effect, as great a decentralization of administrative business as possible by entrusting greater powers to the lower bodies, either by law or by delegation from the higher authorities. Then it seems it will be desirable to grant to the Administrative Board a greater independence from the Minister, so that the latter may be freed from purely management matters.

For the rest, let us mention the following

amongst the measures adopted or envisaged: following on the development of electro-mechanical equipment, the division of the Works and Building Department into a Works Department and an Electrical Equipment and Signalling Department, the transformation of the Central Office of Health into a Department endowed with greater administrative independence, the setting up of Financial Offices within the Districts by the amalgamation of the Accounts Inspectorates and the Cashier's Sections, the mechanisation of Departmental work together with the institution of training courses for staff at the office mechanization centres.

Moreover, the Italian Railway Administration looks forward to reducing the number of grades of staff and only leaving those which are necessary to the chain of command. This step should go with the review of the conditions of recruitment, promotion and remuneration.

## INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th SESSION (LONDON, 1954).

### QUESTION 7.

**Modernisation of the methods to be adopted for recruiting the staff in number and qualification.**

**Harmonious renewal of the various ranks, indispensable reserve lists, ratio of the permanent and temporary staff.**

**Part played by the medical service in the recruiting.**

### SUPPLEMENT TO REPORT

by Frank LEMASS,

General Manager, Coras Iompair Eireann, DUBLIN (Ireland).

Subsequent to the completion of the Report, embodying replies from nineteen Undertakings, replies were received from the Indonesian State Railways and the Rhodesia Railways.

The Indonesian State Railways replied to the questionnaire in detail. The reply from the Rhodesia Railways, however, was furnished in such form that, except in a few instances, it was not possible to include particulars of that Undertaking's practices in the detailed form set out in the Questionnaire.

It should be understood, therefore, that this supplementary report is compiled *on the replies of the Indonesian State Railways*. Where it has been possible to include the reply from the Rhodesia Railways to a specific question this is indicated in each case.

### QUESTIONNAIRE.

#### GROUP 1.

Question 1. — *What is the size of your establishment (number of personnel) and how is it made up:*

- a) *according to function :*  
*unskilled workmen;*  
*skilled workmen;*  
*supervisory staff;*  
*clerical staff;*  
*officials;*  
*technicians (engineers, architects,*  
*etc.) ?*
- b) *according to status :*  
*temporary or casuals (including apprentices);*  
*probationary;*  
*permanent ?*

**Particulars of Establishment.****Answer 1 :**

a) According to function :	
unskilled workmen . . . . .	50 694
skilled workmen . . . . .	7 164
supervisory staff   . . . . .	18 457
clerical staff   . . . . .	
officials . . . . .	104
technicians . . . . .	29
	—
	76 448
b) According to status :	
temporary or casuals (including apprentices) . . . . .	3 769
probationary . . . . .	473
permanent . . . . .	72 206
	—
	76 448

**Question 2 :**

- a) *By what standards do you base your requirements for personnel?*
- b) *How do you watch and control the numbers required in each of your main departments?*
- c) *In the last 25 years, have your tests for deciding requirements altered? Why and in what way?*

**Answer 2 :**

- a) Personnel requirements are based on the numbers necessary to operate and maintain the system.
- b) Controlled on the basis of past experience.
- c) The undertaking states that its tests have altered, but no indication is given of the manner in which the alterations have been effected.

**Question 3. — Do you apply the same tests to evaluate your requirements for permanent staff and for temporary staff?**

**Answer 3. —** The same tests are applied for permanent and temporary staffs.

**Question 4. — What operating considerations or other factors give rise to the employment of temporary staff, and has such temporary employment any advantage other than that arising from economic working?**

*Is there a ratio of temporary to permanent staff and if so, how is this determined? Do the numbers given represent this ratio?*

**Answer 4. —** This is not stated, but it is indicated there is no advantage in the employment of temporary staff. Neither the Indonesian State Railways, nor the Rhodesia Railways has a fixed ratio of temporary to permanent staff.

**Question 5. — Have you observed any difficulties due to recruiting too many temporary staff from the social point of view (numerous and frequent dismissals) the effect on workmanship and the difficulty in coping with sudden demands, etc.?**

**Answer 5. —** After the war, there was an acute shortage of personnel. The difficulties envisaged in this question could, therefore, not arise.

**Question 6. — Are you obliged legally to give any priority in recruiting to war or civil invalids?**

**Answer 6. —** No obligation.

**GROUP 2.****Recruitment of wage grades and clerical workers.**

**Question 1. — From what sources is staff recruited :—**

- a) unsought applications?
- b) replies to advertisements?
- c) State or other employment agencies?
- d) schools, technical colleges, universities?
- e) recommendations?
- f) other sources than above? (Please specify.)

**Answer 1.** — Indonesian State Railways recruit from the sources *a) to e)* only. Rhodesia Railways recruits staff in South Africa, United Kingdom, Ireland, Italy and Holland. In South Africa, recruitment is done mainly through source *b)*, but as well, Locomotive Inspectors are frequently sent on short recruiting tours to recruit Locomotive Firemen, Shunters and Guards.

Recruiting agents are also appointed at the principal towns. Recruitment also made through radio announcements.

In the United Kingdom and Ireland, the London agent of the administration recruits through the medium of newspaper advertisements.

In Italy and Holland — Platelayers and Running staffs recruited through the British Embassies.

**Question 2.** — *Is there within the organisation a systematic plan of recruitment? If so, does this include :—*

- a) timely forecast of vacancies?*
- b) completion of a comprehensive application form by the candidate to ascertain if he meets the necessary physical and other requirements, e.g. age, height, education, past experience, nationality, etc. (Please attach copy of application form or forms in use.)*
- c) the submission of a diploma or certificate or setting of examination for which a stated standard of education is laid down? (Please indicate standards required.)*
- d) a check with Police Department regarding social background?*
- e) a job specification giving the description of the job and the qualities required of the candidate to do the job properly?*
- f) a screening interview to determine the qualities and aptitudes of the applicant? By whom is the interview conducted? (Please give details.)*
- g) psychological tests : if psychological tests are applied, please say by whom*

*i.e. specially trained personnel or outside industrial psychologists? What success has attended their use?*

**Answer 2.** — This Undertaking replied that under existing conditions it has been unable to formulate a systematic plan of recruitment. In certain circumstances, however, minimum educational standards are laid down and the production of an educational certificate is a basic requirement.

**Question 3.** — *Is recruitment conducted by each main department of the organisation or through a central labour or personnel office? Please say under either system, what constitutes the recruitment authority and who makes final selection?*

**Answer 3.** — Recruitment is conducted by the Personnel department. The Head of the Department makes final selection.

**Question 4.** — *Is recruitment continuous or made only at certain intervals?*

**Answer 4.** — Recruitment is made at certain intervals.

**Question 5.** — *What are your induction arrangements? Do they involve :—*

- a) pre-appointment training carried out after selection?*
- b) post-appointment training?*
- c) Does the training course involve :—*
  - « training on the job » only?*
  - training at school or college run by the undertaking? What is the duration of such course?*
  - training with other organisations?*
  - other methods than above? If so, please specify.*
- d) giving new recruits training on company history, policy, wages, promotion, pensions, medical schemes, and amenities generally?*
- e) distribution of booklet relating to the above matters or a book of Rules?*

**Answer 5.** — On the Indonesian State Railways :

a) Pre-appointment training is given to employees engaged in train operations.

The answers given to b), c), d) and e) are : No.

The Rhodesia Railways — all recruits are shown a copy of the terms of appointment, giving details of hours of work, rates of pay, medical and hospital benefits, pension benefits, leave conditions, travelling concessions, housing possibilities and general conditions obtaining in the Rhodesias.

**Question 6.** — *What is the probationary period, if any? Are any examinations carried on during this period? Are in certain cases pass out examinations required at the end of this period?*

**Answer 6.** — No probationary period on this Undertaking.

**Question 7.** — *Do replies to 1 to 6 above apply equally to :—*

- a) temporary and permanent staff?
- b) clerical and wages grades?

*If not, indicate the extent to which the methods vary for the different classes of staff.*

**Answer 7.** — Yes.

**Question 8.** — *Do temporary or former temporary employees receive any special consideration if they apply for a permanent job?*

**Answer 8.** — Temporary employees with not less than one year's service are given preference for permanent employment, provided, they have rendered satisfactory service and are not more than 35 years of age.

**Question 9.** — *Indicate the promotions which can take place within the wage grades before reaching supervisory level. What factors are taken into account in deciding such promotions? Is responsibility for*

*such promotions always a departmental one?*

*Can a member of the wage grades receive promotion to the clerical grade? Under what circumstances?*

**Answer 9.** — Particulars of the promotions which can take place within the wage grades are not given.

The factors taken into consideration in making promotions within the wage grades are :—

- a) the type of position vacant;
- b) seniority position of the candidate seeking promotion;
- c) report as to the efficiency and suitability of the candidate made by the Head of Department;
- d) written examination.

It is not stated if a member of the wages grades can receive promotion to the clerical grade.

**Question 10.** — *What is the procedure for advancement up the clerical scale? How are vacancies advertised? What factors are considered in deciding on promotions? Is ability or seniority regarded as the more important? Has an examination to be passed before promotion can take place?*

**Answer 10.** — The reply given to question No. 9 is referred to in this case.

**Question 11.** — *Are periodic re-examinations carried out in the clerical grades to assess progress? Do the most successful re-examinees receive any encouragement by way of monetary reward or otherwise? What happens to unsuccessful re-examinees?*

**Answer 11.** — Yes — but it is not stated if any encouragement is given to successful re-examinees. Re-examinees who fail the examination on three occasions are debarred from further promotion.

## GROUP 3.

**Recruitment to administrative, technical and supervisory grades.**

**Question 1.** — Are vacancies in :

- a) administrative and executive grades?
- b) technical and scientific grades?
- c) supervisory grades?

filled exclusively from the Undertaking's personnel, or is there any recruitment from outside, such as University Graduates? If from both sources, is there any fixed proportion of one to the other?

**Answer 1.** — Vacancies are not filled exclusively from the Undertaking's personnel. Recruitment is also made from the Universities.

**Question 2.** — Is there any method of assessing potential talent of all available personnel from whom higher positions might be filled? What does it involve?

**Answer 2.** — The potential talent of all available personnel is assessed by educational tests, and by confidential reports received from departmental heads.

**Question 3.** — If recruitment is not exclusively from the undertaking's personnel, what is the source of supply i.e. professions, universities, technical schools, etc.?

**Answer 3.** — The sources of supply outside the Undertaking's personnel are professions, universities and secondary schools.

**Question 4.** — Is there a systematic method of selection? If so, does it include :—

- a) a job specification of vacancies arising describing the work and the requirements needed to do it properly?
- b) any attempt to create a pool of qualified persons to balance expected vacancies?

c) advertising of vacancies :

- within the undertaking?
- outside the undertaking?

d) utilisation of sources of information of all kinds concerning candidates?

e) an Interview Board, other than selection Board, to assist in assessing the general merits of candidates?

f) is there a screening test carried out? What does it involve? Who carries out this test? Give full details.

g) is a psychological examination made? If so, by whom i.e. specially trained personnel or outside industrial psychologists? What success has attended their use?

**Answer 4.** — There is no systematic method of selection.

**Question 5.** — When a diploma is required, how do you proceed with the selection of candidates:

- a) according to the type of degree of the candidate?
- b) by means of an open competitive examination?

**Answer 5.** — Both methods of selection a) and b) are adopted.

**Question 6.** — Do these open competitive examinations consist of written, graphical and oral tests? Have you provided that for certain grades written or oral tests should be set to determine not only the knowledge of the applicants but their intellectual aptitudes and character?

**Answer 6.** — The competitive examination is an oral test, and this test is set to determine the professional qualifications and character of the applicants in addition to their knowledge.

**Question 7.** — On what grounds do you base your choice of either of the above tests?

**Answer 7.** — Choice is based on professional experience.

**Question 8.** — *How do you set about recruiting personnel for vacancies in junior administrative and technical positions and for which vacancies a diploma is not required?*

**Answer 8.** — By the promotion of the Administration's personnel on the basis of seniority and ability.

**Question 9.** — *If you effect your recruiting by open competitive examination, are your existing personnel given priority in any way? How?*

**Answer 9.** — No open competitive examination.

**Question 10.** — *On what do you base the syllabus of such examinations? Do these examinations include written, oral or graphical tests?*

**Answer 10.** — This does not apply.

**Question 11.** — *Are promotions based on seniority or suitability? In the last case, is an examination held? What is the syllabus of this examination?*

**Answer 11.** — Candidates for promotion are required to pass an examination in Station working, general knowledge of the railway service and correspondence. Appointments are made from the lists of successful candidates on the basis of seniority.

**Question 12.** — *Is there a Selection Board, and, if so, does it recommend or make the appointment? Who makes the final selection?*

**Answer 12.** — There is no Selection Board.

**Question 13.** — *Is there a training procedure? If so, does it provide pre- or post-*

*appointment training after selection? Please give full particulars of your methods?*

**Answer 13.** — Yes — Post-appointment training after selection, but no particulars are given.

#### GROUP 4.

##### Apprentices.

**Question 1.** — *Do apprentice training schools exist in any of your departments and to what trades are these apprentices guided?*

**Answer 1.** — There are no departmental training schools, but apprentices receive training in a training school at Bandung. Following are the grades :

Operating and Traffic, Technisists, Overseers, Telegraphers.

**Question 2.** — *What are the conditions for admission? Do children of employees receive preferential treatment?*

**Answer 2.** — The educational standards are :—

a) Operation and Traffic : Elementary School:

b) Technisists : Elementary technical school:

c) Overseers : Secondary technical school;

d) Telegraphers : Simple educational test.

No preference is given to children of employees.

**Question 3.** — *How is the education of the apprentices organised? Day or night classes?*

**Answer 3.** — Day classes.

**Question 4.** — *What is the duration of apprenticeship and what are the arrangement for engaging them? (contract — wages, etc.)*

**Answer 4.** — No reply given.

**Question 5.** — *Is there an official appointed in your organisation to supervise the selection and training of apprentices?*

**Answer 5.** — No reply given.

**Question 6.** — *Do apprentices have absolute priority in being taken into the permanent staff on completion of their training?*

**Answer 6.** — No reply given.

**Question 7.** — *Does their education aim at moulding them into tradesmen capable of tackling successfully, after a few years of experience, the examination set for supervisory grades?*

**Answer 7.** — No reply given.

#### GROUP 5.

##### Part played by the medical service.

**Question 1.** — *What part is played by the medical service during your recruiting? Is its responsibility limited to the time of acceptance into service of the candidates? Or does the Medical Service play its part each time an individual is promoted? Is it applied systematically and regularly in order to examine physical aptitudes of certain individuals? Of whom and at which intervals?*

**Answer 1.** — On the *Indonesian State Railways*, applicants are medically examined before appointment. There are no systematic examinations nor is there medical examination on promotion. The General Manager may direct an employee to attend for medical examination, in certain circumstances.

On the *Rhodesia Railways*, recruits engaged in South Africa are medically examined by the Railway's Medical Officers. Those engaged overseas are medically examined at the place of recruitment and their medical reports are sent to

the Chief Medical Officer, Bulawayo, who confirms or otherwise the candidates' suitability for employment. All new entrants must also undergo an eyesight test including a test for colour blindness.

No information given as to whether or not there are periodic examinations.

**Question 2.** — *Does the decision as to the admission or rejection of candidates rest with the Medical Service or with the Executive?*

**Answer 2.** — On the *Indonesian State Railways* decision rests with the Executive. On the *Rhodesia Railways*, decision rests with the Medical Officer.

**Question 3.** — *Have you set up conditions which decide the physical requirements necessary for your various duties and above all, the physical debilities and ailments likely to debar a candidate?*

**Answer 3.** — On both these Undertakings, there are set conditions which determine the employment of staff.

**Question 4.** — *What constitutes the medical examination?*

a) *for candidates to permanent employment?*

b) *for candidates to temporary employment?*

*Does it entail, in any event, a detailed check (examination of the sensory system, of reflexes, of the heart and lungs, of the sharpness of sight, etc.)?*

*If the medical examination is only cursory for certain forms of employment, what is the extent of such examination and in respect of what types of employment?*

**Answer 4.** — On both Undertakings, the medical examination constitutes a detailed physical check and also vision test.

**Question 5.** — *Is the medical recruiting examination carried out by a full time Medical Officer of the Administration? If not, by whom?*

**Answer 5.** — On the Indonesian State Railways, examinations are carried out by a Medical Board of the Ministry of Health.

On the Rhodesia Railways, examinations are carried out by the Medical Officers of the Administration, except in the case of appointments from Overseas, who are examined by Medical Officers at the recruiting centres who submit their reports to the Chief Medical Officer at Bulawayo.

#### GROUP 6.

##### Labour turnover.

**Question 1.** — *What is the annual personnel replacement rate of the undertaking under present operating conditions :—  
a) for wage grades?  
b) for the rest of the staff?*

*If possible, give variations in the rates over the last 25 years.*

**Answer 1.** — Information not available.

**Question 2.** — *What changes have been made in your establishment during the last 25 years?*

**Answer 2.** — Information not available.

**Question 3.** — *What is the retiring age :—  
a) obligatory (age limit);  
b) by request (right of the individual);  
c) by premature unfitness (average age illness or injuries).*

**Answer 3 :**

a) 55 years

b) 50 years

c)

**Question 4.** — *Are you in a position to furnish a chart showing composition of your permanent staff in age groups (from 20 to 65 years of age or more, according to the obligatory retiring age)?*

**Answer 4.** — This was replied to in the affirmative, but no chart was enclosed.

**Question 5.** — *If, during the last 25 years, you have been compelled to suspend all recruiting for a certain period, what inconveniences were experienced? How and when were these felt?*

**Answer 5.** — Information not available.

**Question 6.** — *Are all employees resigning the service interviewed in order to ascertain their motives for leaving the organisation?*

**Answer 6.** — Employees resigning from the service are not interviewed. It is stated, however, that employees resigning usually give their motives for leaving the organisation.

**Question 7.** — *Is the labour turnover examined insofar as it may reveal :—*

- a) *unrest in the working force?*
- b) *inefficiency :—  
due to unsatisfactory recruitment methods?  
due to unsatisfactory industrial relations?  
in working, due to lack of training or experience in the job?  
caused by lack of interest?*
- c) *economic loss by :—  
having to recruit and train in new employees?  
inefficient working?*

**Answer 7.** — Labour turnover is examined but the reasons for the examination are not specifically stated.

**Question 8.** — *Do you envisage a revision of the scheme by which your personnel requirements are assessed? Do you intend to revise your method of recruitment? What are your plans? What methods do you consider worth while?*

**Answer 8.** — Yes — but the Undertaking is not in a position to give any details at present.

## INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

16th SESSION (LONDON, 1954).

### QUESTION 1.

**What are the present tendencies relating to the organization of the maintenance of the permanent way : methods of determination of the works to be done and in particular, possibilities of the use of detecting-recording coaches, planning of the works, effects of mechanization; importance of the side-tracks for the movement of the gangs and the mechanical devices.**

**Economic and financial aspect.**

## REPORT

*(Belgium and Colony, France and French Union, Greece, Italy, Luxemburg, Netherlands, Portugal and Colonies, Spain, Switzerland, Syria and Turkey),*

by C. FEYRABEND,

Ingénieur en Chef. Chef de la Division de l'Entretien au Service de la Voie et des Bâtiments  
de la Région Sud-Est de la Société Nationale des Chemins de fer français.

### GENERAL CONSIDERATIONS.

To make the permanent way safe enough and comfortable enough for the working of the railway without increasing expenses of all kinds has always been the chief aim of the permanent way maintenance department.

If the situation due to the development of other kinds of transport has reduced the traffic on certain secondary lines, the fight against such competition has led, in order to reduce the working costs, to run over most other routes heavier and heavier wagons hauled by engines on which the weight on the driving axles has tended to increase more and more, whilst the actual speeds have become higher and higher.

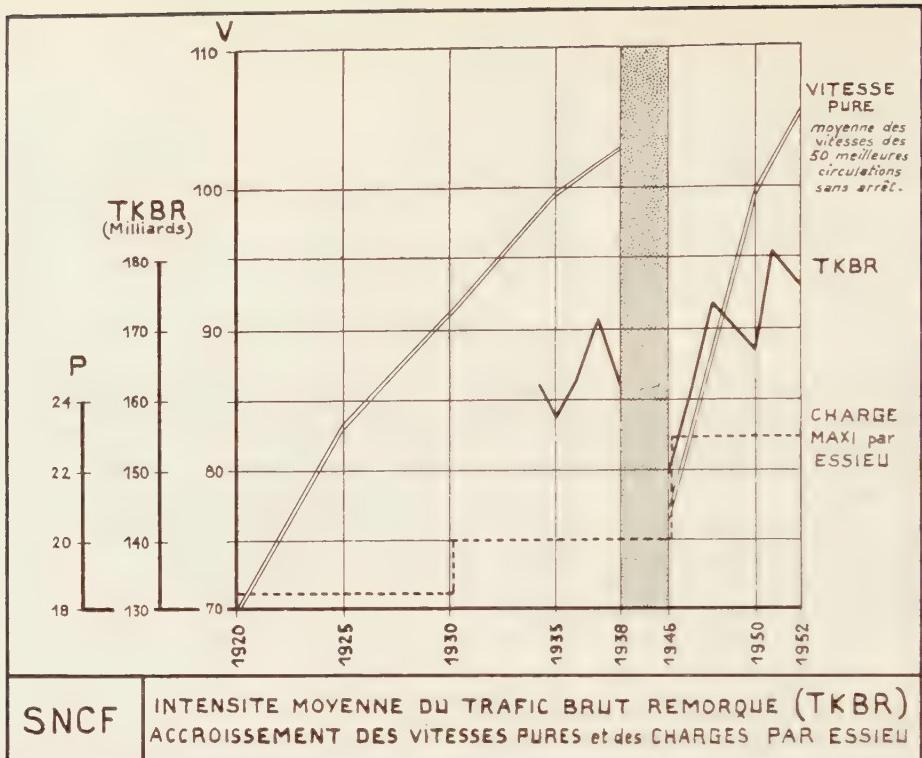
Two graphs, one dealing with the French

National Railways and the other the Swiss Federal Railways show very clearly the increase in the loads which the maintenance department have had to cope with without forgetting the need to keep their costs within the lowest possible limits.

The following study has as its object the comparison of the methods employed by the different Administrations to meet these two requirements.

The work carried out by the permanent way maintenance department has two distinct aspects :

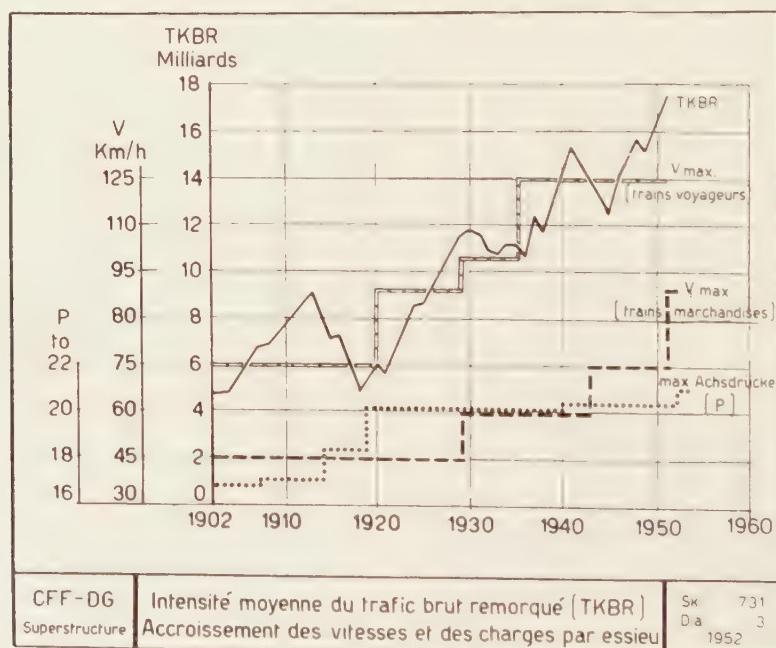
— current maintenance work the object of which is to assure the comfort and safety of the traffic by correcting any defects in the track, such defects being due to wear caused by the traffic, the ageing of the ma-



SNCF

INTENSITE MOYENNE DU TRAFIC BRUT REMORQUE (TKBR)  
ACCROISSEMENT DES VITESSES PURES et des CHARGES PAR ESSIEU

SNCF. — Average volume of traffic hauled (TKBR). Increase of the speeds and loads per axle.  
Charge maxi. par essieu = maximum load per axle.



CFF-DG  
Superstructure

Intensité moyenne du trafic brut remorqué (TKBR)  
Accroissement des vitesses et des charges par essieu

Sk 731  
Da 3  
1952

CFF-DG. — Average volume of traffic hauled (TKBR). Increase of the speeds and loads per axle.  
Trains voyageurs = passenger trains. — Trains marchandises = freight trains.

terial and the influence of seasonal or exceptional atmospheric conditions on the actual permanent way and on its bed;

— important renewals of the track, due either to the need to strengthen it in order to meet important increases in the speed, axle loads, or the traffic, or the need to replace material which has reached the limit of wear after which current maintenance costs become too high.

The examination of the questions dealing with these two classes of operations has already figured on many occasions on the agenda of Sessions of the International Railway Congress Association.

The problem to be dealt with this year has a special character however. Instead of dealing with the technique of the material used on the permanent way or the equipment used, both from the point of view of maintenance and renewal, it deals essentially with the organisation of current maintenance.

In order to make the limits of the investigation quite clear, the questionnaire sent out to the different Administrations has a foreword which we think it advisable to recall at this point :

« By maintenance, must be understood the whole of the operations intended to keep the track in a good state of repair between two complete relayings, as regards safety and comfort, corresponding to the needs of the line in question. »

The information <sup>(1)</sup> supplied by the Administrations will enable us to see how they have reduced or are endeavouring to reduce the annual cost per kilometre for maintenance, whilst at the same time im-

proving the quality of the work done. This improvement should in particular make it possible to increase the life of the materials used and extend the period between two systematic renewals.

*The guiding principles upon which the questionnaire was based.*

Before going on to examine the replies received, we should like to make it clear, in order to facilitate the discussions which will take place at the Congress, the guiding principles upon which the questionnaire was based, the five main parts of which correspond to the different propositions forming Question 1 on the agenda of Section 1.

Apart from certain statistical information, the questions set in the first part had as their essential object the determination of the influence of the different factors <sup>(1)</sup> which led to the present regional organisation of the maintenance gangs of the Administrations concerned. They also are intended to ascertain if this organisation is looked upon as final or if, on the contrary, new systems are under trial, especially in order to take into account progress in mechanical equipment.

The 2nd Part concerns the method of determining the work to be carried out. There would be no object in perfecting increasingly efficient tools and methods of operating as economic as possible if their application was not preceded by a very careful determination of the points at which intervention is useful, and a very careful study of the nature of the operations to be carried out.

The drawing up of these programmes after actual inspection was generally very lengthy, so that we asked the Administrations to make it clear whether they carry out such inspection from one end to the other or only at trial points, and moreover, if they have perfected any recording devices

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<sup>(1)</sup> In particular the obligations resulting from having keepers at level crossings.

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<sup>(1)</sup> The Questionnaire which was drawn up in collaboration with the other Reporters was sent in our case to 57 Administrations belonging to the countries listed at the beginning of the report. We received 26 replies, i.e. 46 %.

As far as the mileage in operation is concerned, the replies received represent 106 361 km (66 090 miles) out of the 130 477 km (81 075 miles) operated by all the Administrations concerned, i.e. 81 %.

allowing of rapid and complete investigations being made.

The very careful study of the localities concerned and the operations to be carried out supposes implicitly an equally careful check of the work done, as it is essential to be sure that it has been completely and correctly carried out.

The third part deals with the actual carrying out of the work and in particular with the degree of mechanisation achieved by different Administrations. It appeared of interest to learn in such different fields of experience as those represented by the railways questioned :

- the motives which led each of these Administrations to go in for mechanisation to a greater or lesser degree;

- the kind of equipment best suited to their actual situation (the perfecting of the technique of small engines having opened up new possibilities in the matter of equipment);

- and finally the operations and conditions of the permanent way which seem to them most favourable for the development of mechanisation.

The 4th Part deals with the problem of pathways alongside the track. The replies received for the previous parts may, in effect, show on the one hand the interest there is in having fairly large gangs, and on the other the need certain Administrations experience to leave part of their staff living at different points on the line in order to carry out the necessary supervision and act as keepers at level crossings.

This necessity immediately raises the problem of collecting the gangs together and the methods to be used to allow the men to move alongside the line when getting to work or when the gang has to move from one site to another.

The 5th Part deals with the economic and financial aspect, the information asked for having as its object :

- a)* to compare the unit maintenance costs of the different Administrations as now

organised; the latter should also in addition define if possible the evolution of the amount of labour used over the last thirty years.

- b)* to ascertain the advantages of the methods under trial or being introduced compared with the classical methods from the point of view of the amount of labour and total costs.

A few subsidiary questions bring out the factors which result from the financial point of view in some of the advantages due to the new organisation being lost.

Four Appendices are intended to supply additional information in connection with :

- the 1st : equipment;

- the 2nd : the distribution of the duties of the maintenance gangs;

- the 3rd : the unit costs;

- and the 4th : the materials used for the permanent way by the different Administrations.

An analysis of the replies received led us to ask a few additional questions in order to find out in the case of lines with the same amount of traffic

- the maximum speed and the speeds actually run;

- the average kilometric length;

- the average length of the section for which a gang is responsible and the number of men in the gang;

- the average hourly rate of pay of platelayers and the cost of an hour's work, taking into account the different deductions from the wages.

The replies have been summed up in the 5th Appendix.

## FIRST PART.

### A. — Statistical data.

Tables I and II which give brief details of the constitution and traffic of each of the different Administrations, and of the equipment of the permanent way, show the

very great differences existing between them. These differences are due :

a) to the geographical situation of the railways concerned, some of which are operating in countries with an age old civilisation whilst others on the contrary are in new countries with a very low population density;

b) to the nature of the operating, some railways serving a whole country with lines having very different characteristics and very diverse traffic, whilst others on the contrary only operate a few lines, sometimes only one line, for transporting the produce of an industrial region to the ports which are sometimes some hundreds of miles away.

This difference in the position in which the different Administrations find themselves presupposes that the maintenance principles now in force and their probable evolution will show a great deal of difference. This evolution must in fact depend to a large extent upon the geographical, economic and social conditions of the country served by the railway in question. It must not be expected therefore that any uniform technical solution will be discovered from the replies as a whole as regards the organisation of the work, the equipment and the materials used, which will solve once for all the productivity problem with which the different Administrations are faced.

## B. — Local organisation.

### 1. Influence of the general inspection of the lines :

- a) are the maintenance gangs responsible for providing keepers at the level crossings ?

For the great majority of Administrations, special employees (male or female) are employed as keepers at level crossings. But the members of maintenance gangs have to take over the duties of keepers in any emergency (rest periods, holidays, sickness) and if needs be for considerable

periods, when it is impossible to recruit keepers for example. Moreover in many cases, only the families of employees will live in houses at a distance from the towns.

The French National Railways (<sup>1</sup>) state that such duties include in addition getting up at night (<sup>2</sup>) for opening the gates by employees living at the level crossing (the husband of crossing keeper) up to a limit of 60 times a month.

The few Administrations on which the keepers of level crossings are supplied from the maintenance gangs are the Gafsa Railway, the Catalan Railways, the Viet-Nam Railways and the Greek Railways (<sup>3</sup>).

### b) what other supervisory obligations fall upon the maintenance gangs (inspection tours, etc.) ?

In addition to carrying out keepers duties as reported in the previous paragraph, the maintenance gangs are responsible for the general supervision of the lines on all the Railways which replied.

This supervision is usually carried out by tours of inspection the organisation and periodicity of which vary considerably (see paragraph d below).

The maintenance gangs are also responsible for the following duties on certain Administrations :

— the servicing of the block signalling on the main lines of the Italian Railways and certain regions of the S.N.C.F.;

— the maintenance and inspection of the points on the Moroccan Rys.;

(<sup>1</sup>) Designated by S.N.C.F. throughout the remainder of this Report.

(<sup>2</sup>) An allowance of 30 min. each time he has to get up.

(<sup>3</sup>) However this Administration makes it clear that only keepers attached to the gang carry out keepers duties, though the gang is responsible for stand-ins, which seems to imply that it is in fact question of a specialised job which merely comes under the jurisdiction of the Foreman Ganger.

Name of Administrations	Length	
	single track <i>a</i>	double track <i>b</i>
	kilometres	kilometre
<b>BELGIUM and COLONY :</b>		
<i>Belgian National Railways (S.N.C.B.)</i> . . . . .	2 299	5 421
<i>Office d'Exploitation des Transports Coloniaux (OTRACO)</i> . . . . .	350	30
<b>SPAIN :</b>		
<i>R.E.N.F.E. Red Nacional de los Ferrocarriles Españoles</i> . . . . .	11 277	3 584
<i>Catalan Railways</i> . . . . .	132.6	»
<b>FRANCE, ALGERIA, TUNISIA and FRENCH UNION :</b>		
<i>French National Railways (S.N.C.F.)</i> . . . . .	22 940	36 067
<i>French Light Railways</i> . . . . .	1 590	»
<i>Régie Autonome des Transports Parisiens (R.A.T.P.)</i> . . . . .	»	389
<i>Algerian Railways</i> . . . . .	4 247	325.5
<i>Gafsa Railway</i> . . . . .	455	»
<i>Tunisian Railways</i> . . . . .	1 553	34
<i>Cameroons Railways</i> . . . . .	500	4.9
<i>West African and Togo Railways</i> . . . . .	3 714	80
<i>Franco-Ethiopian Railway</i> . . . . .	781	»
<i>Madagascar Railways</i> . . . . .	861.85	»
<i>Moroccan Railways</i> . . . . .	1 537	60
<i>Mediterranean-Niger Railways</i> . . . . .	275.3	»
<i>Viet-Nam Railways</i> . . . . .	923.8	3.5
<b>GREECE :</b>		
<i>Greek Railways</i> . . . . .	1 280	»
<i>Thessalian Railway</i> . . . . .	201	»
<b>ITALY :</b>		
<i>Italian State Railways (F.S.)</i> . . . . .	11 317	8 290
<b>LUXEMBURG :</b>		
<i>Luxemburg Railways</i> . . . . .	219.4	346.5
<b>NETHERLANDS :</b>		
<i>Netherlands Railways (N.S.)</i> . . . . .	1 057	3 262
<b>PORTUGAL and COLONIES :</b>		
<i>Portuguese Railways</i> . . . . .	3 196	750
<b>SWITZERLAND :</b>		
<i>Swiss Federal Railways (C.F.F.)</i> . . . . .	1 741	2 372
<i>Rhaetian Railway</i> . . . . .	390	»
<b>SYRIA :</b>		
<i>Syrian Railways</i> . . . . .	247.2	»

(1) By units of track equipment must be understood :

- 1 branch with two tracks. . . . .      1 unit
- 1 branch with three tracks . . . . .      2 units

Length of all other lines		Total number of units of track equip- ment (1)	Total length $d + 0.3e$ + 0.1f	Gross annual tonnes km	Average daily output per km of main lines
metres	kilometres	kilometres			
87	7 807 380	5 339 188	34 900 925	12 899 529	28 143 410 399 1 400 000 000
16	14 877 » 132.6	3 346 47.5	18 543 494	17 735 196.25	30 575 575 300 167 900 000
760	60 767	21 452	152 586	82 461	180 000 000 000
»	1 590	140	1 550	1 787	230 000 000
»	389	112	1 115	534	4 965 000 000
»	4 572.5	557.2	4 072	5 146.9	4 533 691 400
»	455	68	392	515	1 090 000 000
»	1 587	180	1 129	1 754	992 000 000
»	505	57.99	414	563.8	308 000 000
»	3 794	555	2 168	4 178	1 560 340 621
»	781	36	321	823.9	399 788 357
»	861.85	70.3	614	944.34	87 866 100
»	1 597	310	1 716	1 761	3 650 000 000
»	275.3	4.6	99	286.6	118 000 000
»	927.3	"	600	997.3	388 000 000
»	1 280	302	1 510	1 522	1 307 000 000
»	201	24	170	225.2	32 500 000
60	19 667	5 392	51 611	26 446	56 830 187 000
»	365.9	127.7	2 104	801.88	1 476 043 000
12	4 331	1 869	16 398	6 532	18 000 000 000
»	3 946	585	1 855	4 308	3 580 000
»	4 113	2 175	18 344	6 600	17 484 612 800
»	390	83	1 111	526	268 906 790
»	247.2	42.4	155	275.4	37 900 000
					420

simple junction crossing	2 units
double junction crossing	4 units
ordinary crossing	1 unit

Name of Administrations	Length of main lines on sleepers		
	wood	metal	concrete and other
	kilometres	kilometres	kilometres
BELGIUM and COLONY :			
<i>Belgian National Railways (S.N.C.B.) . . . . .</i>	6 816	960	31
<i>Office d'Exploitation des Transports Coloniaux (OTRACO) . . . . .</i>	»	380	»
SPAIN :			
<i>R.E.N.F.E. Red Nacional de los Ferrocarriles Españoles . . . . .</i>	14 700	177	»
<i>Catalan Railway . . . . .</i>	132.6	»	»
FRANCE, ALGERIA, TUNISIA and FRENCH UNION :			
<i>French National Railways (S.N.C.F.) . . . . .</i>	55 500	4 284	983
<i>French Light Railways . . . . .</i>	1 590	»	»
<i>Régie Autonome des Transports Parisiens (R.A.T.P.) . . . . .</i>	389	»	»
<i>Algerian Railways . . . . .</i>	2 576.1	1 628.6	367.8
<i>Gafsa Railway . . . . .</i>	5	450	»
<i>Tunisian Railways . . . . .</i>	699	869	19
<i>Cameroons Railways . . . . .</i>	»	505	»
<i>West African and Togo Railways . . . . .</i>	»	3 730	64
<i>Franco-Ethiopian Railway . . . . .</i>	»	781	»
<i>Madagascar Railways . . . . .</i>	769	92.85	»
<i>Mediterranean-Niger Railways . . . . .</i>	275	»	0
<i>Moroccan Railways . . . . .</i>	103	1 446	48
<i>Viet-Nam Railways . . . . .</i>	227	700	0.3
GREECE :			
<i>Greek Railways . . . . .</i>	58	1 222	»
<i>Thessalian Railway . . . . .</i>	201	»	»
ITALY :			
<i>Italian State Railways (F.S.) . . . . .</i>	19 081	579	7
LUXEMBURG :			
<i>Luxemburg Railways . . . . .</i>	553.2	12.4	0.3
NETHERLANDS :			
<i>Netherlands Railways . . . . .</i>	4 322	»	9
PORTUGAL and COLONIES :			
<i>Portuguese Railways . . . . .</i>	3 946	»	»
SWITZERLAND :			
<i>Swiss Federal Railways . . . . .</i>	1 176	2 936	1
<i>Rhaetian Railway . . . . .</i>	97	293	»
SYRIA :			
<i>Syrian Railways . . . . .</i>	»	247.2	»

(1) In the case of the information requested concerning the weight per metre of rails now on order, ce

## EQUIPMENT OF LINES

Length of secondary lines on sleepers			Rails	Sleepers (number of sleepers per kilometre)
wood	metal	concrete and others	Weight per metre <sup>(1)</sup>	
kilometres	kilometres	kilometres	kilogrammes	
5 086	43	210	50	1 500 to 1 722
»	188	»	33.4 to 40	»
3 307	39	»	45	»
47.5	»	»	»	»
21 094	277	81	46 to 55	1 300 to 1 722
140	»	»	30	1 300
112	»	»	46 to 52	»
557.2	»	»	46 — 48	1 500
1	67	»	36	1 333
124	56	»	36 to 46	1 350 to 1 750
»	58	»	30	»
»	555	»	30	1 500
»	36	»	»	»
69.8	0.5	»	26 and 30	
4.6	»	»	35 to 39	1 200
200	20	90	46 — 55	1 333 to 1 611
»	»	»	30	1 420
10	292	»	46	»
24	»	»	»	»
5 238	26	128	49 and 60	1 500 and 1 708
127.7	»	»	46	1 680
1 869	»	»	38 — 46	1 333 to 1 666
585	»	»	39.8 to 55.695	1 666
1 356	785	34	45.93	1 556
»	83	»	30.1	1 468
4.6	37.8	»	»	1 249

istrations gave a scale of figures relating to the weights of rails now in service.

- working the points at crossings where there is no Operating Department staff on the Gafsa Railway;
- replacing the station inspectors during holidays on the Rhaetian Ry.;
- replacing the bridge and line inspectors during absences of not more than 5 days on the Syrian Rys.

c) *how do these obligations affect the geographical organization of your gangs?*

Although the great majority of Administrations replied in the negative to this question, the remainder of their replies showed very definitely the implicit effect of these obligations on the geographical organisation. The subjections due to the necessity for inspection and the practically universal obligation to lodge men at the level crossings to make sure that some member of the family can act as keeper are to some extent lost sight of in the traditional organization of small gangs used at the present time by most Administrations.

The small radius of action of these gangs makes it possible to have men available along all the lines without taking any special steps. The case would be quite different were these small gangs to be done away with and their place taken by large gangs with a wider radius of action; the subjections imposed by the need for inspection would then appear in their true light.

In this connection, the Italian Railways estimate that the inspection obligations would make it necessary to have staff distributed all over the system, consequently the retention of relatively short sections.

This opinion is shared by the Swiss Railways, whose system is characterised by a large number of level crossings at which the platelayers live, and by the need to keep a close watch at dangerous points on their mountainous lines. This Administration reports however that they are not building new keepers houses.

- d) *do you have various types of organization corresponding to the greater or lesser importance of their supervisory obligations (lines with very heavy traffic, lines with very little traffic, mountain lines, etc.)?*

Like their replies to question c), most of the Administrations state that the influence of the supervision required is not the chief factor in the choice of the geographical distribution of the gangs. These Administrations mention as more important factors : the density of the installations to be maintained, the mechanisation of the maintenance work, the grouping of the staff in centres or villages in regions where the population is sparse.

The reply of the S.N.C.F. shows however that if on lines through fairly level country, they have considerable liberty in the choice of their geographical organisation, this is not so in the case of mountain lines where certain obligations (removal of snow and ice, etc.) raise problems which have not yet been solved in order to allow of the organisation of long sections.

This point of view is also shared by the Madagascar and Swiss Railways, the latter clearly stating that in certain cases where this is justified by topographical conditions preference has been given to gangs consisting of a small number of men responsible for a short section.

In replying to this question, the majority of the Administrations gave fairly complete details about the organisation of the inspection tours worked on their territory, which we have summed up in Table III below.

- e) *can you characterize such organizations according to the relative number of men days spent on supervisory duties?*

The few replies received only deal with this question indirectly giving either as a percentage, or as the number of days required for their system as a whole, the burden

TABLE III.

ADMINISTRATIONS	Periodicity of the circuit				Annual cost of inspection obligations in man days per km of line
	Daily	Twice Weekly	weekly	Monthly	
S.N.C.B. . . . .					
R.E.N.F.E. . . . .	x				
S.N.C.F. . . . .	except.	except.	x		
Régie Autonome des Transports Parisiens (R.A.T.P.) . . . .				lines of Cat. 4	
Algerian Railways . . . . .					5 days
Gafsa Railway . . . . .			x (in principle)		for the urban system 18 days
Tunisian Railways . . . . .			x		6.5 days
Cameroons Railways . . . . .					5.05 days
West African Railways . . . . .					34 days
Moroccan Railways . . . . .					30 days (investi- gation in hand to reduce this to 8 or 10 days)
Franco-Ethiopian Railway . . . . .					
Mediterranean-Niger Rys. . . . .					
Viet-Nam Railways . . . . .					
Italian State Railways (F.S.) . . . . .					
Portuguese Railways . . . . .			x (gang foreman)		41 days
Syrian Railways . . . . .					

involved in inspection obligations without linking this up with the organisation of the gangs.

To enable this information to be compared, we have turned it into the number of man days required for inspection per km of track; this is given in the last column of the above table.

The S.N.C.F. indicate moreover that in addition to the indirect burden of providing accommodation at level crossings, the direct share of the maintenance gangs in acting as keepers at level crossings may be taken as 382 500 days per annum for the railway as a whole, or 6.3 d. per km of track, a figure which is higher than the cost of the inspection tours.

f) do the supervisory requirements make it necessary for you to house the men at points along the line?

The replies given to this question chiefly show the influence of the demographical position of the different regions.

In the case of Railways operating in regions where there is a very dense population and where the traffic as a rule is intense, this problem does not arise. The lines are run over at frequent intervals, the staff naturally live in the near-by towns which are very close together, as it is the case in Belgium, Holland and the industrial regions of the other European countries.

The opposite demographical situation leads to the same conclusion; it is in fact

not possible to put the men in isolated accommodation in certain semi-desert or uninhabited regions of Africa or Asia. The Administrations have therefore been obliged either to group their staff in communities near the stations or to set up camps which are in fact villages (West Africa, Cameroons, Syria).

On the other hand, in countries with an average density of population such as the agricultural regions of Spain, France, Italy, Portugal and Greece, the staff usually live along the line. They have usually been distributed in this way since the creation of the railways, so that the problem of inspection is implicitly solved as we stated above.

Finally, the general shortage of accommodation in towns which makes it very difficult, if not impossible, to group the men into large gangs living in the towns, frequently obliges the railway for reasons other than the need for inspection to leave the men in their present accommodation along the line and hides the real problem in these particular cases.

It can however be presumed that there is such a tendency as it must be noted that on the lines where there is no accommodation problem, it is becoming increasingly difficult to find men willing to live in the very isolated houses (<sup>1</sup>). Moreover, the reduction in the traffic on certain lines makes it possible to space out the tours and carry them out by means of light engines which have a much wider radius of action.

These two factors make it possible to think that in many cases it will be possible to combine in the future the requirements of inspection with the constitution of much larger gangs accommodating the men in towns where the living conditions are much better than in the case of isolated houses.

(<sup>1</sup>) For example the Swiss Railways are no longer building keepers houses. Tunisia is not rebuilding the keepers houses destroyed during the war.

2. *Influence of geographical conditions :*  
 a) do housing difficulties make it necessary for you to group the men into gangs working at times at a distance from their homes?

As we reported in connection with the previous question, housing facilities are not an unimportant part in the organisation.

Italy for example reports that the housing shortage in the large towns obliges her to accommodate her staff in the neighbouring villages at some distance from their place of work.

The following Administrations have been able to group their men under certain conditions :

in FRANCE :

- by the *S.N.C.F.*  
 the creation of long sections and radiating sections for the maintenance of certain co-ordinated lines accommodating the staff in the central stations.  
 creation of special regional and Area gangs which travel and live in special trains to assist local gangs in their maintenance work.
- by the « *Chemins de fer Economiques Français* (<sup>1</sup>) »  
 long sections over all the system.
- by the *Algerian Rys*  
 creation of sections (long distance sections). At the present time, there are 152 long sections and 66 ordinary sections.
- by the *Gafsa Ry*  
 creation of long sections to obtain sufficiently large gangs and get better use of the methods of transport and common pool of mechanical equipment.
- by the *Tunisian Rys*  
 regrouping of the gangs, the number of which has been reduced from 193 in 1939 to 28 in 1953.

(<sup>1</sup>) Designated by C.F.E. in the remainder of this Report.

TABLE IV.

NAME OF ADMINISTRATIONS	Method of getting to work				
	on foot	by bicycle or motor- cycle	by lorry or rail road	by trolley	by train
BELGIUM and COLONY :	Cannot supply any details				
S.N.C.B. <i>OTRACO</i>	100 % at present	»	!	»	100 % in the future
SPAIN :	generally used				
R.E.V.F.L. <i>Catalan Railway</i>	rarely used	»	used	»	used
FRANCE, ALGERIA, TUNISIA AND FRENCH UNION :	100 % »				
<i>S.N.C.F.</i>	83 %	3 %	3 %	1 %	
<i>C.F.E.</i>	»	»	»	normally	
<i>R.A.I.P.</i>	»	»	»		100 %
<i>C.F.A.</i>	20 %	75 %	5 %	»	
<i>Gafsa Railway</i>	15 %	85 %	under consid.	»	»
<i>Tunisian Railways</i>	6.5 %	0.5 %	93 %	»	»
<i>Cameroons Railways</i>	100 %	»	»	»	»
<i>West African Railways</i>	100 %	»	»	»	»
<i>Franco-Ethiopian Railways</i>	100 %	extending the use of lorries carrying tools and materials			
<i>Madagascar Railways</i>	50 %	»	»	48 %	2 %
<i>Vietnam Railways</i>	68 %	32 %	»	»	
<i>Viet-Nam Railways</i>	»	»	»	5 %	95 %
GREECE :	on foot and by lorry				
<i>Greek Railways</i>	95 %	rarely			5 %
ITALY :	generally				
<i>F.S.</i>					when the section is more than 5 km away
LUXEMBURG :	35 %				
<i>Luxemburg Railways</i>	45 %	»	»	»	20 %
NETHERLANDS :	1 %				
<i>Netherlands Railways</i>	95 %	4 %	»	»	»
PORTUGAL :	92.5 %				
<i>Portuguese Railways</i>	»	7.5 %	»	»	»
SWITZERLAND :	used				
<i>C.F.F.</i>	used	used	exceptionally	used	up to the station used
<i>Rhaetian Railway</i>	used				
SYRIA :	on foot to the centre				
<i>Syrian Railways</i>					from the centre to working site

TABLE V.

ADMINISTRATIONS	QUESTION c)		QUESTION d)
	Time allowed	Supplements in cash	
BELGIUM AND COLONY :			
S.N.C.B. . . . . OTRACO . . . . .	The gangs never work far from their homes no		practically none none
SPAIN :			
R.E.N.F.E. . . . . Catalan Railways . . . . .		yes, when the man is working outside his section yes	none 2 o. o
FRANCE, ALGERIA, TUNISIA AND FRENCH UNION :			
S.N.C.F. . . . .	yes, after $\frac{1}{2}$ hour on going to and coming back from work, at the rate of 5 minutes per km for bicycles, 15' per km on foot, half the time by train, trolley and lorry.		travelling allowance for use of bicycle and meals taken out.
C.F.E. . . . .	yes, after $\frac{1}{2}$ hour going to and coming back from work, a time which is rarely exceeded		40 %
R.A.T.P. . . . . C.F.A. . . . . Gafsa Railway . . . . . Tunisian Railways . . . . .	no yes yes yes, after $\frac{1}{2}$ an hour each way.	no travelling allowance " " " " no travelling allowance " " "	Sceaux line 70 % 30 % 12 % none, unless the working site is at section headquarters or nearby.
Cameroons Railways . . . . . West African and Togo Railways . . . . . Franco-Ethiopian Railway . . . . .	no no no	no no yes when outside the section	20 % only when the gangs are



- by the *Moroccan Rys*  
creation of long sections on a line running through country which is practically uninhabited.
- by the *Mediterranean-Niger Ry*
- by the *Ethiopian Rys*
- by the *Viet Nam Rys*
- in GREECE :
- by the *Thessalian Rys*
- in PORTUGAL :
- by the *Portuguese Rys.*

b) *the men may go from their homes to work on foot, by bicycle, motor cycle, lorry track or by train. Can you give in each case the approximate percentage throughout the year of men using each of the above methods of transport?*

Table IV before sums up the replies received. It will be seen that individual responsibility for transport, on foot, bicycle or motorcycle, is more general than the use of collective transport. The very extensive use of lorries for transport in Algeria should however be noted.

- c) *when a gang frequently has to work a long way from home, do you have to reduce their working hours or pay additional wages?*
- d) *what is the average number over the year of men able to have their midday meal at home?*

Table V sums up the replies received to these two questions.

### 3. Influence of the equipment :

- a) *has the influence of above two factors been preponderant in determining the present organisation of your gangs and has it led to choose methods of maintenance depending upon the use :*

- of hand tools (used individually by gangs of average size);
- of motors and motorised equipment (used by large gangs) ?

The replies received to questions 1c) and 2a) show that the majority of the Administrations consider the effects of inspection as of little importance and that of the geographical situation as only secondary. Consequently they have not given any factors enabling their present organisation and their equipment to be linked up with these elements. We have already stated above that in our opinion parasitic factors mask at the present time their real incidence which is very far from negligible.

Only the Franco-Ethiopian Ry. reports the necessity for inspection and rapid repairs on a single track line exposed to frequent atmospheric phenomena as limiting the concentration of the gangs and justifying the present maintenance methods using hand tools.

- b) *have you any new methods of organization under trials, and what were the chief motives for making such trials? How do you reconcile them with supervisory and geographical problems?*

All the railways are studying modifications in the traditional maintenance organisation. These studies have, however in most cases only reached the stage of trials concerning research into organisation or the most favourable techniques as regards productivity. In general, the form which such organisation will take in the future has not yet been determined. Only a few Administrations, such as the Algerian, Tunisian and C.F.E. appear to have accomplished their evolution towards organisations showing a clear break with the old methods.

Although the studies being carried out by the other Administrations naturally are based each upon their own characteristics,

they can be grouped into two categories :

— those intended merely to improve the potential of the gangs by concentrating them and giving them suitable means of transport;

— those intended to develop the use of mechanical equipment to reduce the amount of labour required.

The solutions studied by certain Administrations such as the S.N.C.F. do not quite fall into either of these two categories.

Only two Administrations have gone into details regarding the solution to inspection problems in the case of using large gangs :

— the Portuguese Railways which have solved this problem by separating the duties : the members of large gangs are

only responsible for inspection duties close to their homes, inspection duties at the ends of the section being carried out by an employee who lives at each end and has no other duties:

— the S.N.C.F. whose large gangs travel in special trains does not require such gangs to undertake any inspection duties, these being the responsibility of local gangs.

c) *do these trials cover long sections?*

d) *how long have they been going on?*

Table VI below sums up the replies received and confirms that in general, in all cases, it is merely a question of trials.

TABLE VI.

ADMINISTRATIONS	Extent of the trials	Length	Remarks
<i>a) Concentration of the gangs and development of methods of transport.</i>			
<i>OTRACO</i>	over the whole system	in hand	Concentration about every 50 km
<i>Algerian Railways</i>	over the whole system	for the last 15 years	
<i>Tunisian Railways</i>	over the whole system	since 1936	
<i>Gafsa Railway</i>	60 km	beginning	
<i>Moroccan Railways</i>	650 km	20 years	
<i>Portuguese Railways</i>	433 km	7 years	
<i>Rhaetian Railway</i>	limited section	6 months	
<i>b) Mechanisation trials.</i>			
<i>S.N.C.B.</i>	on service sidings	since 1953	
<i>S.N.C.F.</i>	4 400 km	1940 to 1952	
<i>C.F.E.</i>	800 km	2 years	
<i>Tunisian Railways</i>	over the whole system	in hand	
<i>West African Railways</i>	limited section	a few months	
<i>Madagascar Railways</i>	limited section	2 years	
<i>Viet-Nam Railways</i>	limited section	6 months	
<i>Greek Railways</i>	one gang per section	in hand	
<i>Netherlands Railways</i>	over the whole system	1950	1 mechanised gang living in a coach

## 4. Mechanisation index figure :

If the mechanisation characteristic of an organisation can be given by the ratio :

Total power in HP

of all the motors or tools available  
average number of men

please give this ratio :

- for your railway as a whole?
- for the section of your railway where mechanisation is most highly developed.

We have given in table VII below the figures sent in.

Some of these however appear to us to err on the generous side and probably include the transport machines which should have been excluded from the calculation.

We would state, in addition, that according to the information we collected during a journey to the United States in 1952, the mechanisation index in that country amounts to about 3 HP per man.

TABLE VII.

ADMINISTRATIONS	Mechanisation index	
	For the system as a whole	For sections where mechanisation is greatest
BELGIUM and COLONY : . . . . .		
S.N.C.B. . . . .	$\frac{2623cv}{3150_a} = 0^{cv}.19$	
FRANCE, ALGERIA, TUNISIA and FRENCH UNION : . . . . .		
S.N.C.F. . . . .	$\frac{6094cv}{42368_a} = 0^{cv}.15$	$570^{cv}$ $300_a$ $1^{cv}.9$
C.F.E. . . . .	$= 0^{cv}.15$	$0^{cv}.35$
R.A.T.P. { Urban line . . . . .	$\frac{37cv}{144_a} = 0^{cv}.26$	
{ Sceaux Line . . . . .	$\frac{26cv}{50_a} = 0^{cv}.52$	
Tunisian Railways . . . . .	$\frac{80cv}{742_a} = 0^{cv}.11$	
West African Railways . . . . .	$\frac{160cv}{4000_a} = 0^{cv}.04$	
ITALY : F.S. . . . .	$\frac{580}{10359} = 0^{cv}.056$	$\frac{580}{1000} = 0^{cv}.58$
NETHERLANDS : . . . . .		
Netherlands Railways . . . . .	$\frac{260cv}{4000_a} = 0^{cv}.065$	
SWITZERLAND : . . . . .		
C.F.F. . . . .	$\frac{770cv}{3470_a} = 0^{cv}.22$	

cv = HP.

## PART TWO.

### METHOD OF DETERMINING THE WORK TO BE DONE, POSSIBILITY OF USING RECORDING VEHICLES.

#### A. — Classification of the lines.

##### 1. How do you determine :

- a) the permanent way equipment?
- b) the number of men required for maintenance?

*Is this done in terms :*

- of the kind of trains (predominantly passenger or goods)?
- of their speed?
- of their number (daily tonnage);
- of the maximum axle load (of wagons or locomotives)?

##### 2. Does your classification of the lines depend on the above data or do you base it upon other characteristics?

The replies received from the different Administrations do not, as a general rule, give more than an indication of the factors upon which the equipment of the lines are based and the determination of the labour required, without however precising in a quantitative way the effects of these factors.

These replies are summed up in the table given in Appendix VI which also includes the more detailed information supplied by certain Administrations.

#### B. — Cycle of operations.

##### 1. Maintenance work can be broken down into :

- a) work done according to predetermined cycles;
- b) work done after systematic surveys;
- c) work done gradually, when necessary.

##### 2. What operations would you group under each of these 3 headings?

We have summed up in Table VIII hereafter the generally very detailed information supplied; we think however that there has been a certain ambiguity in the interpretation given to sub-questions a) and b).

#### a) Work carried out according to predetermined cycles.

Railway Administrations are usually important undertakings where the Management has no direct and permanent contact with the executives.

It is essential however that the Management can be assured that the work is being carried out in such a way as to guarantee safety and to avoid that the installations need to be renewed all at the same time. The General Rules must foresee for this purpose a checking processus and the necessary overhaul of the components which condition the safety of the traffic and the conservation of the installations.

Such overhauls are concerned above all with the parts of the track that age relatively slowly : the superstructure and the ballast in particular. In order to keep the gangs in regular work, each year a given section of the permanent way is dealt with, so that the whole system is overhauled within a certain period. This is known as the « integral overhaul zone ».

The overhaul of the superstructure and ballast, generally includes a certain deconsolidation of the track; it is usually accompanied by a check of the level and alignment.

A clear distinction must be made between these periodical overhauls and large scale renewals. Whereas the latter include the systematic replacement of all the track components or all the ballast, the first only covers the replacement of those parts which cannot wait for the next overhaul.

A judicious determination of the latter is one of the essential elements of the preparation of the work of the integral overhaul.

## Breaking down of work

ADMINISTRATIONS	Work carried out according to predetermined cycles			
	Overhaul of the material	Levelling and rectifying the gauge	Adjoining ground	Other work mentioned by the Administrations
BELGIUM and COLONY : <i>S.N.C.B.</i> . . . . .				Revision of points and switches, tightening up the fastenings, rectifying the gauge - shoveling packing the joints.
<i>OTRACO</i> . . . . .				
SPAIN : <i>R.E.N.F.E.</i> . . . . .				
<i>Catalan Railways</i> . . . . .				Improving the ballast.
FRANCE, ALGERIA, TUNISIA and FRENCH UNION : <i>S.N.C.F.</i> . . . . .				Cleaning the ballast in zones covered by the cycle and the following operations : annual tightening up of the fastenings, inspection of the expansion gaps, sounding the rails, inspecting and lubricating joints.
<i>C.F.E.</i> . . . . .				
<i>R.A.T.P.</i> (urban line) . . . . .				General overhaul — every 2 5 years — grinding the tracks (every 2 years) weeding maintenance of points and switches.
<i>Sceaux Line</i> . . . . .				General overhaul every 3 4 years.
<i>Algerian Railways</i> . . . . .				On all lines after more than years. Tightening up.
<i>Gafsa Railway</i> . . . . .		X		
<i>Tunisian Railways</i> . . . . .				
<i>Cameroons Railways</i> . . . . .	X			Only done when there is general removal or replacement more than 150 sleepers per — ballasting.
<i>West African and Togo Rlys.</i> . . . . .	X	X	X	Lubricating the transmissions Weeding — tidying up cleaning bridges.

## Involved in maintenance

Work carried out after systematic inspection				Work carried out after investigation	
Continuous levelling and rectifying	Levelling of joints and rectifying	Replacing of materials which cannot await the regular overhaul (burnt sleepers for example)	Other work mentioned by the Administrations	Correction of local defects	Other work mentioned by the Administrations
»	»	Regulating the joints - restoring the gauge	»	»	Displacements - earthworks - cleaning ditches - replacing worn components - additional ballast.
		Levelling and rectifying limited to small defects.			Levelling, keying, rectifying and consolidating the sleepers and small components.
		Replacement of material limited in general to burnt sleepers.			
×	×	Renewal of the ballast, track components - repairs to isolated joints.	idem	×	Rectification, levelling, replacing sleepers. Replacing broken rails, small components, chairing joints, building up rails, cleaning out drains.
»	»			×	Regularization of curves, rectification of the gauge.
×	×	On lines of less than 8 years. Large scale replacement of material.		×	Particularly on secondary lines.
×	×	All systematic takings up and replacement of at least 150 sleepers per km.			
×		Cleaning the ballast.		×	Keying, lifting, insulation. Maintenance of service sidings and branches - Repairing damage caused by the Winter.

## Breaking down of w

ADMINISTRATIONS	Work carried out according to predetermined cycles			
	Overhaul of the material	Levelling and rectifying the gauge	Adjoining ground	Other work mentioned by the Administrations
<i>Franco-Ethiopian Railway</i>				Cleaning the ballast if necessary.
<i>Madagascar Railways</i>				RI and RR — without changing the rails.
<i>Moroccan Railways</i>				Cleaning the ballast.
<i>Mediterranean-Niger Rys.</i>				Overhaul every two years.
<i>Viet-Nam Railways</i>				No programme owing to events.
GREECE : <i>Greek Railways</i>				Systematic weeding.
ITALY : <i>F.S.</i>	×		×	By contract.
LUXEMBURG : <i>Luxemburg Railways</i>				On lines of the 1st and 2nd categories.
NETHERLANDS : <i>Netherlands Railways</i>				A few operations every two or five years according to the classification of the line.
PORUGAL and COLONIES: <i>Portuguese Railways</i>				Cleaning the ballast.
SWITZERLAND : <i>C.F.F.</i>	>			Repairing ends of rails by welding.
Rhaetian Railway				
SYRIA : <i>Syrian Railways</i>				As the system is completely overhauled, the other works are limited to

olved in maintenance

Work carried out after systematic inspection				Work carried out after investigation	
Continuous levelling and rectifying	Levelling of joints and rectifying	Replacing of materials which cannot await the regular overhaul (burnt sleepers for example)	Other work mentioned by the Administrations	Correction of local defects	Other work mentioned by the Administrations
×			Tightening the fastenings—cleaning adjoining land—cleaning out ditches. General overhaul—regulating the bed—cleaning the ballast at other than the general overhaul.	×	Replacing components. Tamping joints, tightening up fastenings, correcting faulty sections.
×	×		Weeding—carrying drainage water off—cleaning out ditches sounding the rails—overhauling the joints.	×	
»	»	»	»	×	Replacing sleepers which have become too worn between two overhauls; checking the fastenings and raising low joints.
			Weeding, screening the ballast—checking the laying plane—overhauling the fastenings.	×	
			By contract, apart from measured shovel packing on certain sections of the system which is carried out by the maintenance gangs.	×	Weeding. Renewing the ballast. Renewing wood sleepers on bridges. Tightening up the fastenings. Levelling by welding and replacing worn components.
»	»	»	»	×	Overhauling the material, rectifying and levelling lines in category 3.
		×	»	×	
»	»	»	»	×	
×	×	×		×	
×	×	×		×	Building up earthworks, cleaning ditches and cuttings—weeding.

hauled on a five year cycle, the methodical operations  
sidings of large stations.

b) *Work carried out after a systematic survey.*

On lines with heavy traffic and those run over by passenger services at relatively high speeds, the ageing of the qualitative factors of the track (level, wedging, aligning and tightness of the fastenings) can lead to an appreciable reduction in the comfort; the aggravation of certain defects can also lead to excessive fatigue of the track components and rolling stock. A certain overhaul of these factors is therefore required between two periodical overhauls. It would however be against the principles of good management to seek to remedy these defects every year by continuous work over the whole of the system not included in the periodic overhaul.

Most times, it is sufficient to treat limited areas, the extent of which varies considerably on lines with different traffic characteristics and even on one and the same line according to the kind of bed; the determination of such areas is based on systematic surveys.

c) *Work carried out after discovery of any defect.*

We think that a very clear distinction should be made between work carried out discontinuously coming under heading b) above which is the result of a continuous study, and work carried out as a result of the discovery of local defects which have developed or been discovered during the course of the year. The correction of the latter, although necessary, is usually costly as it interrupts the regular work of the gangs.

3. *What is the relative importance of each of these operations on the different categories of lines?*

The amount of work coming under these different categories varies a great deal according to the size of the railway and the kind of traffic on the different lines (Table IX hereafter).

The same difficulties of interpretation as occurred with the preceding question may have arisen and the percentages given in column 1 may include factors which should have been put in column 2.

4. *In the case of operations carried out according to a cycle, does this depend upon the classification of the line?*

The connection between the repairs cycle and the classification of the line was only clearly defined by those Administrations who gave detailed replies to Question A-1 on the determination of these categories. These are :

in FRANCE :

— the S.N.C.F.

- a 4-year cycle on 1st. Category lines.
- a 5-year cycle on 2nd. Category lines.
- a 6-year cycle on 3rd. Category lines.

NORTH AFRICA :

— the Moroccan Rys

- a one year cycle on lines with high speed and heavy traffic.
- a 3-year cycle on the other lines.

SWITZERLAND :

— the C.F.F.

- a 3 to 4-year cycle on the main lines of Category 1.
- a 4 to 6-year cycle on the main lines of Category 2.

The other Administrations which replied in the affirmative and supplied a certain amount of information are the following :

in AFRICA :

— the Tunisian Rys

- a maximum cycle of 4 years.

— the Algerian Rys

- the cycle depends on the category and age of the line.

— West African Rys

- a 2-year cycle which is only binding in the case of lines with a sufficiently strong permanent way and correctly ballasted.

TABLE IX.

ADMINISTRATIONS	Length of section on which work has been done		
	According to predetermined cycles	According to systematic inspection	On investigation
BELGIUM and COLONY :			
S.N.C.B.		Levelling : all the lines in the case of important lines — half or a third in the case of other lines.	
FRANCE, ALGERIA, TUNISIA and FRENCH UNION :			
S.N.C.F.	Lines of : 1st Cat. 25 %   50 % } about 2nd Cat. 20 %   30 % } 3rd Cat. 16.6 %   20 % } 4th Cat. : Work according to programme.   25 % } 10 % about		
C.F.E.	65 to 80 % accord- ing to the line.   »   from 20 to 30 % according to lines		
R.A.T.P.	Urban system : 75 %   22.8 %   2.2 %		
Tunisian Railways	Sceaux Line : 31 %   47 %   22 % 10 %   60 %   »		
West African Railways	70 % on poorly ballasted lines and worn material.   »   40 to 50 %		
Moroccan Railways	36 %   5 %   3 %		
Mediterranean-Niger Railways	62 "   "   38 %		
Viet-Nam Railways	5 %   10 %   85 %		
ITALY :			
F.S.	Lines of 1st Cat. : with 70 trains daily: 50 %   50 % Trains $\geq 50 < 70$ : 25 to 33 %   75 to 66 % Lines of 2nd Cat. : Trains $\geq 20 < 50$ : 25 to 33 %   60 to 33 % Lines of 3rd Cat. : Trains $< 20$ :   33 %		

## in ASIA :

- the Vietnam Rys  
a 2 to 3-year cycle on the main lines and  
3 to 5 years on the service lines.

## HOLLAND :

- the Netherlands Rys  
a 2 to 5-year cycle for certain operations  
only.

*5. In the case of operations carried out after a survey, is this done directly or by taking recordings?*

The inspection covers the factors affecting the quality of the track (level, alignment, gauge, wedging) and the condition of the material.

For these factors of quality the Administrations generally make use of recordings for the determination of the sections requiring overhaul, direct inspection being limited to the determination of the elementary work as we shall see in Question C-2.

As regards the materials, it appears that only direct inspection is used, no recording devices being able to determine its quality. Only the S.N.C.F. are beginning to use a coach to detect certain defects in the rails.

*6. In the case of direct surveys, does this embrace the whole line or is it only made at various points?*

Belgium, Italy, Switzerland, the C.F.E., the Gafsa Ry. in particular stipulate inspection throughout; other Administrations such as the Algerian and the S.N.C.F. state it depends on the case.

The S.N.C.F. in particular considers, at least in the case of the material, the inspection of sample sections suffices in the case of homogeneous routes, whereas a complete inspection is on the contrary recommended in the case of heterogeneous routes of varying quality.

*7. Are recordings made by light machines running over the lines or by special vehicles?*

*8. In the latter case, do you record the position of the rails or the reactions of the vehicle?*

Recording vehicles can be classified into three categories :

— special vehicles which record various details about the position of the rails;

— Halide apparatus which records the reactions of the vehicle;

— light machines running over the rails which give a direct reading together with a recording of a limited number of factors usually for example the inclination, any warping and the gauge.

More detailed information about the characteristics of these machines, the kinds of records obtained with them and the Administrations using them are given in Appendix VII.

**C. — Determination of the elementary work to be carried out.**

The questions included under the heading B above deal essentially with the principles and methods of determining the sections requiring overhaul and the kind of work to be done there. The following questions deal more particularly with the determination of the amount of work and the method of carrying out the elementary work.

*1. What managerial grade decides the details of work to be done?*

The determination of the elementary work is generally the responsibility of the local managers : the District Manager (or his counterpart) and the Section Manager (or his counterpart) together with the gang foreman.

On the « Régie Autonome des Transports Parisiens » the determination of the elementary work depends upon a program-

me drawn up by the Departmental Manager at the suggestion of the Divisional Manager from the recommendations made by the Sectional Managers.

*2. Are direct surveys or recordings used?*

*3. From your experience what operations are most suitable for each of these methods?*

All the Administrations made use of direct inspection whether it is a question of correcting the factors upon which the quality of the line depends or material factors.

Such inspection is facilitated in the case of the quality factors by a detailed examination of the recordings upon which the sections to be overhauled were determined.

It should be noted that the Swiss Federal Rys. state that they are endeavouring to extend the use of records showing the behaviour of the track under load.

We give in Appendix VIII an example of the inspection of a section to be overhauled by means of a recording and the determination of the elementary work by direct inspection.

**D. — Control of the way the work is done.**

*1. When the work is completed, do you make a systematic check of the quality of the work?*

*2. Is this check made by direct continuous survey or by surveys at given points, or is it done by using a recording vehicle?*

All the Administrations replying to this question carry out a more or less thorough control of the way the work is done.

Such a check is made either :

— by direct inspection throughout in the case of 9 Administrations;

— by sample inspection by 8 Administrations;

— by a combination of the two methods by 6 Administrations.

All the Administrations who have recording vehicles complete the records made before the work is done by further records showing the quality of the work done.

The Italian Rys., where the work is usually carried out under contract, report that the quality of the work done by the contractors is systematically checked by monthly tours of inspection with Hallade equipment and the Iezzi and Pollak light machines.

Appendix VIII shows a record checking the effectiveness of work done.

### PART THREE.

#### ORGANISATION OF THE WORK. AMOUNT OF MECHANISATION.

**A. — General considerations.**

*1. Do you carry out all the maintenance operations simultaneously over a given length of track, or do you divide it up into elementary phases which are carried out in turn?*

Fourteen of the twenty-three Administrations who replied to this question divide the work involved in an overhaul into its elementary phases.

In the case of their long sections, however, the Moroccan Railways prefer to carry out the whole overhaul in one phase in order to avoid having to take the gang to the same place several times.

*2. What do these phases consist of (levelling, shimming, lining, overhauling the material, for example)?*

Although the replies received to this question differ on certain points, it can be concluded that most Administrations in general make a distinction between :

*a)* the overhaul of the material, with, if necessary, screening and cleaning of the ballast;

*b)* overhaul of the layout : levelling throughout or merely at the joints, and rectification of the gauge.

A few Administrations also mention as separate operations the overhaul of the material, cleaning the line, weeding and clearing up the track on some overseas railways.

*3. Do you divide the operations involved in overhauling the material into several phases?*

The Belgian, S.N.C.F., C.F.E., Tunisian and Swiss Federal Railways divide up overhauling the material into several phases. On the other hand, a certain number of the other Administrations prefer to carry out this overhaul in a single phase; this is often the case with track laid on metal sleepers where the overhaul of the material is not usually very extensive.

As far as the organisation of the work is concerned, there is a temptation to carry this breaking down of the overhaul operations very far in order to profit from the benefits of specialisation which makes it possible :

*a)* to form gangs always doing the same work during the whole of the overhaul, which means better productivity, better appreciation of the actual materials required, better preparation of the tools required and easier control after the work has been done;

*b)* to carry out each operation at the best time of the year and do those operations for which the weather does not matter at periods when other work cannot be carried out.

On the technical plane however, these advantages are counterbalanced by the drawbacks due to tightening up and loosening the fastenings too frequently, which results in a rapid decrease in the resistance of the coachscrews to pulling out.

The best solution appears to be the grouping of the elementary operations into a certain number of phases. For example reshaping the sleepers, correcting the gauge and consolidating the coachscrews are often carried out during the same phase dealing with sleepers which can remain in the track after the fastenings have been overhauled.

*4. In what order are these operations carried out, and what reasons led you to adopt this particular order?*

The order in which the different phases are carried out is determined in such a way that no further work of the kind will have to be done during the following phases on fastenings which have been overhauled or screwed into new sleepers.

There are in general 4 phases in the overhaul of the material :

- a)* the correction of the layout, including the replacement of any rails if necessary;
- b)* overhauling the joints;
- c)* overhauling the fastenings;
- d)* replacing sleepers,

the first two phases can be grouped together if the gang is large enough.

The 9 Administrations, who replied to this question, agree that the work should be carried out in the order given above.

They also state that the overhaul of the material should take place before levelling and rectifying operations which would not be very effective on a track where the materials were not in a satisfactory state.

We give below as an example a graph (fig. 1) showing the distribution over the year of the work required of a gang on a section completely overhauled according to the cycle (general overhaul) and the remainder of the section where the operations required in connection with qualitative factors are determined by systematic inspection (gang of 8 to 10 men working manually).

The general tightening up of the fastenings has to be done every year on track laid in the classical manner with coachscrews. This operation is included in the different phases of the overhaul of the material for the zone treated according to the cycle. It is generally carried out at the end of the year on the rest of the section.

*5. Do you impose speed restrictions when certain operations are being carried out?*

VOIE 1 kilomètre: 3	ZONE TRAITÉE EN FONCTION DU CYCLE		ZONE TRAITÉE APRÈS PROSPECTIONS SYSTEMATIQUES		n
	4	5	6	7	
JANVIER	Terrassements - Fossés				
FEVRIER	Révision des appareils de voie				
MARS	Niv.lement des rails		Niv.lement après		
AVRIL				Prospection	
MAI	Vérification des jeux - Désherbage - Fauchage - Entretien des obstacles				
JUIN	Corr. position des attaches				
JUILLET	Consolidation des traverses				
AOUT	Niv.lement - Dressage				
SEPTEMBRE	Entretien des voies de service et des appareils sur voies de service				
OCTOBRE			Serrage général des attaches		
NOVEMBRE	Entretien des voies de service (suite)				
DECEMBRE	Sécurité				
	Terrassements - Fossés - Talus - etc...				

Fig. I.

## Explanation of French terms

Voie 1 = track 1. — Janvier = January. — Février = February. — Mars = March. — Avril = April. — Mai = May. — Juin = June. — Juillet = July. — Août = August. — Septembre = September. — Octobre = October. — Novembre = November. — Décembre = December. — Zone traitée en fonction du cycle = section dealt with according to cycle. — Zone traitée après prospections systématiques = section dealt with after systematic inspections. — Terrassements = earthworks. — Fossés = ditches. — Correction du plan de pose = correction of layout plan. — Revision des appareils de voie = overhaul of switches. — Traitement des joints = treatment of joints. — Nivellement d'après prospection = levelling according to survey. — Vérification des jeux = checking play. — Désherbage = weeding. — Fauchage = mowing. — Entretien des obstacles = maintenance of obstacles. — Consolidation des attaches = consolidation of fastenings. — Remplacement des traverses = replacement of sleepers. — Nivellement = levelling. — Dressage = rectifying gauge. — Entretien des voies de service et des appareils sur voies de service = maintenance of sidings and switches on sidings. — Serrage général des attaches = tightening up fastenings generally. — Semaine de sécurité = safety week. — Talus = banks.

Four Administrations systematically impose speed restrictions :

— R.A.T.P., to assure the safety of the staff whilst working on the urban system;

— the Swiss Federal Rys. state that they limit the speed to 75 km (46 miles)/h where shovel packing is being done (this method of working is in process of being introduced) owing to the type of track (70 % laid on metal sleepers) and the sinuosity of the lines. The object of this restriction is the safety of the staff and traffic.

— the « OTRACO » impose a speed restriction of 50 km (31 miles)/h at working sites.

— the Madagascar Rys.

On all the other railways, speed restrictions are only imposed where there is large scale replacement of sleepers or rails, important overhauls to the sleepers, or general overhauls.

The S.N.C.F. consider such speed restrictions useless for the following reasons :

— when several consecutive sleepers have to be replaced, this is done in several stages of one sleeper out of three;

— overhauls of the fastenings are carried out alternately on each line of rails;

— at the mechanised working sites of large gangs which may cover several hundred metres, work is done under protection during the intervals between trains;

— on mechanised working sites with small gangs, where only a few sleepers are dealt with at a time, only one line of rails and only on one side of these, the work can usually be done without protection, coachscrews essential to the safety being replaced and tightened up in a few seconds between the warning of the approach of a train and its arrival.

#### B. — Influence of the traffic on mechanisation.

1. In the case of sections where mechanisation is now highly developed, how

*many trains run during the time the work is being carried out?*

a) *on the track concerned?*

b) *on the adjoining track or tracks in the case of multitrack lines?*

The figures vary from 30 trains on the Netherlands Railways to 6 trains on the Franco-Ethiopian Ry. (single track).

The average is usually 10 trains either on the line in question or the adjoining line.

2. *What is the practical duration of the long intervals which the gangs provided with mechanical equipment can count on?*

The intervals obviously depend upon the amount of traffic on the line in question. They are quite long on certain overseas railways (whether or not there is mechanisation) : 5 hours on the OTRACO and 6 hours on the Viet-Nam Rys. — and usually about 1 to 3 hours on most other railways.

The Swiss Federal Rys. state that their normal intervals are 30 to 50 minutes, but they endeavour to increase them to 4 hours by agreement with the Operating Department when mechanical tampers are being used so that the machine can be used efficiently.

The same problems arise on other railways as the use of heavy mechanical tools running on the track is often incompatible with the heavy traffic on the line.

The maintenance work can only be mechanised on such lines by designing light machines easy to take off the line.

3. *What is the average interval below which they cannot commence working?*

This interval varies from 15 to 45 minutes according to the railway. Our experience leads us to believe that a gang can resume work for 15 minutes when they are using individual mechanical machines easily taken off the rails.

In the case of large machines (mechanical tampers for example) the necessary intervals vary from 20 minutes (considered long enough by the Swiss Federal) to 45 minutes and 1 hour according to the other Administrations.

*4. Is the track protected during work :*

- a) *by mobile signals?*
- b) *from the stations?*

Only eleven Administrations replied to this question.

Five use moveable signals exclusively.

Five use moveable signals as well as the station signals.

The S.N.C.F. give the following details :

— on working sites of large gangs, safety is assured by moveable signals displayed by a look-out at the regulation distance about 1 200 m (1 300 yards). This is completed by a long distance warning [7 to 13 km (4 to 8 miles)] intended to assure the regularity of the traffic working by enabling the machines to be taken off the rails in good time, the order to cease work being given before the train can be seen by the look-out:

— on small working sites : protected at the regulation distance, when visibility is less than 35° corresponding to about 1 200 m at 120 km (74 miles)/h; otherwise the men get off the line when the look-out warns them as soon as he sees or is advised of the arrival of a train.

*5. What warning do you give to make sure the gang and equipment are clear of the line in time?*

Eleven replies were received to this question likewise.

The most usual device is an audible

- levelling by mechanical tamping . . . . .
- consolidation of the material (fastenings).
- tightening up the fastenings . . . . .

signal : trumpet or whistle completed in certain case by a telephone line between the look-out and the foreman and the neighbouring station or stations.

The S.N.C.F. consider that a trumpet is the most suitable instrument for manual gangs; sirens worked by compressed air or electricity are used in the case of mechanised gangs, the power of the warning selected depending on the number of machines working simultaneously.

The Italian Railways are studying an audible and luminous warning operated by a mechanical pedal or sentry from a distance.

*6. How much time is lost every time a train passes in getting clear and bringing back the mechanical equipment?*

The replies given by the few Administrations who dealt with this question vary considerably as regards the elementary time. However, it can be deduced that the time lost in removing and returning the heavy machines to the line is about 5 to 10 times greater than that lost with light machines.

*7. Is mechanisation particularly extensive in the case of work in connection with :*

- a) *levelling, shimming and lining up;*
- b) *consolidating the material;*
- c) *replacing the material;*
- d) *cleaning the ballast (including weeding);*
- e) *maintenance of the surrounds (ditches, embankments, etc.)?*

Twelve Administrations replied to this question. These are divided as follows according to the operations for which mechanisation has been most developed :

10 Administrations.

5 Administrations.

8 Administrations.

- replacement of material . . . . .
- cleaning the ballast .
- maintenance of the surrounds .

In addition to these classic operations, mention must be made of building up rail ends and welding rails on the track to eliminate defective joints.

#### C. — Kind of equipment.

1. *Can you give a list of the tools or motors used by your gangs, stating :*
  - a) *whether these are self-contained tools or motors, or groups of tools working off a motor generating set;*
  - b) *the power and average weight of these tools or motors;*
  - c) *the method of moving these motors or tools (rails or paths).*

(See for information the table given in the Appendices.)

Appendix I lists the most widely used tools and the number of Administrations using them either as regular practice or for trial purposes.

Table X sums up the data supplied by certain Administrations relating to questions a), b) and c).

2. *Which are the ones you are most likely to develop?*

There is a general tendency to make use of coachscrewdrivers cutters and drills for sleepers, notchers and tampers generally

#### 2 Administrations.

In both cases however these are not maintenance operations, but general renewals which lie outside the scope of this report.

- 2 Administrations use screening machines.
- 6 Administrations make use of chemical weed-killing.

#### 2 Administrations :

the Algerian Rys, who use angledozers for scraping and levelling.

the Tunisian Rys who use caterpillar tractors equipped with angledozers or bulldozers for building up small banks and clearing.

carrying out the compaction of the sleeper bed by vibration.

The S.N.C.F. and Swiss Federal Rys. mention the value they attach to the designing of individual tamping machines or machines which can be removed very quickly from lines with heavy traffic where they will still give a satisfactory output. Progress in the technique of small engines will enable designers to perfect in the near future machines meeting such requirements whose work will be the equal of that done by machines running on the rails.

#### D. — Use of mechanical tools.

1. *Is the present organisation of your mechanised gangs the result of successive trials?*

The 7 replies received agree on the need for long and extensive trials to organise mechanised gangs.

If supplying the gangs with well designed tools is necessary if mechanisation is to be successful, this in itself is not sufficient. During the 40 or more years that designers have studied mechanical tools, it will be noted that these generally have only been designed to facilitate the carrying out of certain elementary tasks, the technique of which had already been perfected by the manual gangs. For example, first of all, mechanical coachscrewdrivers and tampers were invented, then according to the development of the overhaul of the material,

drills, cutters, slotters, reamers, etc. Supplying such machines to the gangs affects the organisation of the work because of the difference they make to the fundamental time ratios. The resulting modifications can go much further than the mere reorganisation of a gang, and affect the whole organisation of a line.

The fact has not escaped the notice of engineers, who already some 25 years ago were seeking to develop mechanical equipment. We may quote in this connection the words of M. TETTELIN, who represented in 1930 at the Madrid Congress the railways which had gone the furthest in mechanisation at that time :

« The mere fact of mechanical equipment, the fact that its use has been decided upon, necessitates a reorganisation of the labour which is going to use it on quite different lines from that current when there was no mechanical equipment. »

« When mention is made of the regular distribution of labour over the system, we are still under the dominion of a state of affairs which did not include mechanical equipment. »

Such considerations make it easy to understand why lengthy and numerous trials dealing not only with the equipment but also the organisation of the gangs are required in order to ascertain all the conditions requisite to the success of such a change-over.

The development of mechanisation is therefore largely conditioned by the possibility of altering the existing organisation and adapting it to other obligations than those which the actual maintenance imposes on the maintenance staff.

*2. Can you give any diagrams showing the functioning of gangs using mechanical tools or motors?*

The limited space available for this report prevents us from publishing all the diagrams received. We will therefore only give, amongst those Administrations who have developed their studies of mechanisation, those sent in by three of them whose railway systems have very different characteristics owing either to the kind of traffic, or their geographical situation.

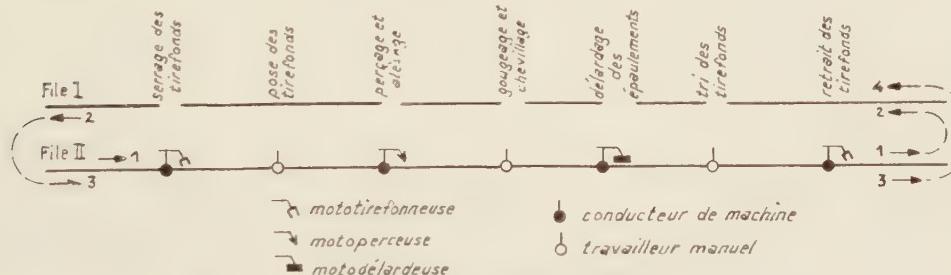


Fig. 2. — French C.F.E. — Consolidation gang of 7 men.

*Explanation of French terms:*

File I = line I. — File II = line II. — Serrage des tire-fonds = tightening coachscrews. — Pose des tire-fonds = putting in coachscrews. — Perçage et alésage = drilling and reaming. — Gougeage et chevillage = chiselling and pinning. — Débridage des épaulements = cutting the bearing surfaces. — Tri des tire-fonds = loosening coachscrews. — Retrait des tire-fonds = removing coachscrews. — Mototirefonneuse = motor coachscrewdriver. — Motoperceuse = motor drill. — Motodélardeuse = motor-cutter. — Conducteur de machine = driver. — Travailleur manuel = labourer.

The work proceeds as follows :

- half sleeper on the inside of the track, line I;
- half sleeper on the inside of the track, line II;
- half sleeper on the outside of the track, line I;
- half sleeper on the outside of the track, line II.

TABLE X.

ADMINISTRATION	Tools or machines used						
	Type	Power	Weight	Moved on	Type	Power	Weight
BELGIUM (1) :							
S.N.C.B. . . . .	»	»	»	cutters, tamper, coach-screw- drivers.	4 HP 5.7 HP 2 HP	» » »	path- ways
FRANCE and FRENCH UNION :							
S.N.C.F. . . . .	3 to 4 HP	110 k average	rails	Same machines as in column 1 in the propor- tion of 15 %.	» » »	» » »	
C.F.E. . . . .	3 to 5 HP	110 k to 150 k	rails			» »	
R.A.T.P. . . . .	2 HP 5 coach-screw- drivers, sleeper drills, cutters.	70 k	Seaux Line : coach-screw- drivers, drills.	2.5 to 7 HP 1 to 1.5 HP	80 to 140 k 18 to 40 k	rails	

<i>Madagascar Railway</i>	Sleeper drills, pneumatic vibrators, tampers, Matisa ballast removers.	2 to 4 HP	»	rails
		»	»	

<i>Moroccan Railway</i>	Ballast removers, Matisa screens, Matisa tamper, Jami coach-screwdriver.	120 HP 50 HP 3/5 HP	12.5 t 9.5 t 120 k	rails
<b>SWITZERLAND :</b>				
<i>C.F.F.</i>	Drills for sleepers, coach-screw-drivers, tampers, screens.	1/2 HP 55 HP 80 HP 100 HP	120 to 180 k 10 t 20 t	rails
<i>F.S.</i>	Rails saws.	4 HP	80 k	rails
<b>ITALY :</b>				
<i>Rail drills</i>		2 HP	80 k	Electric generating sets on other lines.
				Tamper, Coach-screw-drivers, Sleeper drills,
				8 HP 5 HP 2 HP
				350 k 80 k 70 k
				rails

(1) On this system maintenance at the present time is practically limited to the coach-screws.

Two men complete the work by checking any small defects which may remain after the motor tools have been used.

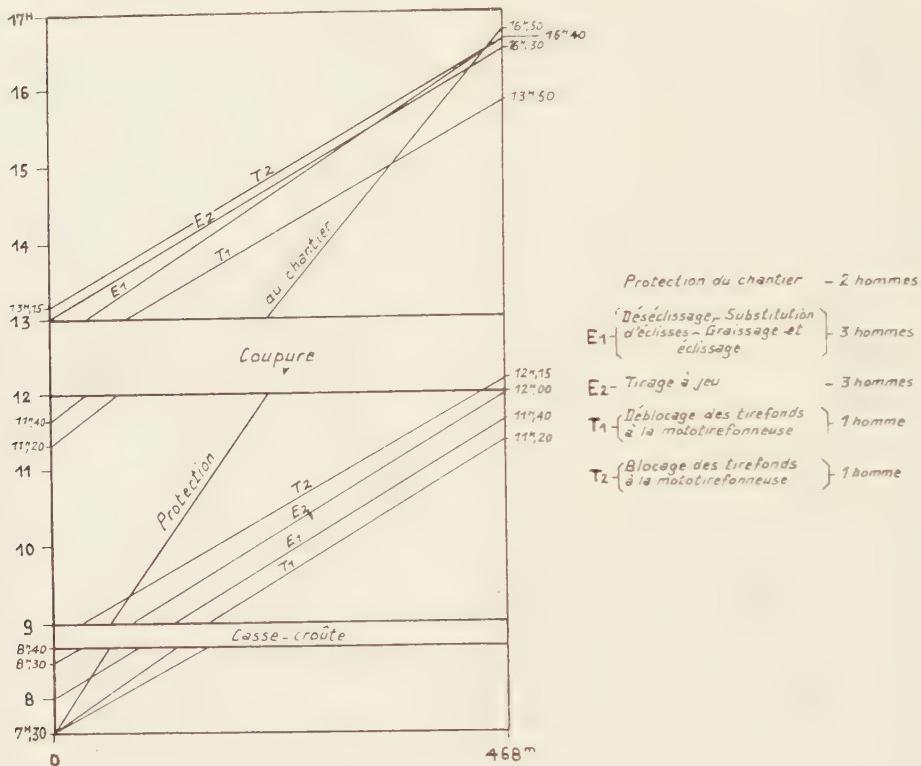


Fig. 3. — Tunisian Railways. — Gang of 10 men.

*Explanation of French terms:*

Protection du chantier — 2 hommes = protection of the work — 2 men.

E1 = removing fishplates;  
changing fishplates;  
lubricating and fishplating } — 3 men.

E2 = regulating the play — 3 men.

T1 = unscrewing coachscrews with motor coachscrewdriver — 1 man.

T2 = tightening cop coachscrews with motor coachscrewdriver — 1 man.

S.N.C.F. — The diagrams sent in by the S.N.C.F. relate to overhauls of the material by gangs of very different sizes : large gangs living in special trains, average sized gangs formed by grouping together 2 or 3 local maintenance gangs, and local gangs temporarily supplied with mechanical equipment.

We will deal in the following chapter

(E) with the technical value of these different organisations and in the 5th part with the results obtained from the economic point of view.

The two graphs hereafter (fig. 10 and 11) show the work of an ordinary maintenance gang equipped in turn with the tools required to enable it to carry out different types of maintenance work.

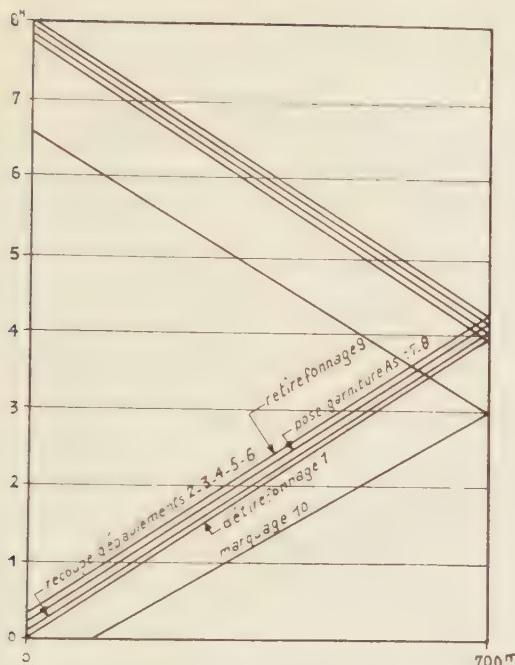


Fig. 4. — Gang of 10 men recutting the bearing surfaces and consolidating the coach-screws.

*Explanation of French terms:*

- 1 = unscrewing the coachscrews.
- 2.3.4.5.6 = cutting the bearing surfaces.
- 7.8 = finishing off.
- 9 = tighten up coachscrews.
- 10 = marking.

3. Has the introduction of mechanisation obliged you to modify your ideas about the grouping of maintenance operations and the order in which they are carried out?

The importance of the modifications involved in the introduction of mechanisation in the grouping of maintenance operations and the order in which they are carried out depends to a great extent on the organisation of the work done by the gangs manually and the evolution that has already taken place as regards the separation of the elementary operations essential in the case of mechanised jobs.

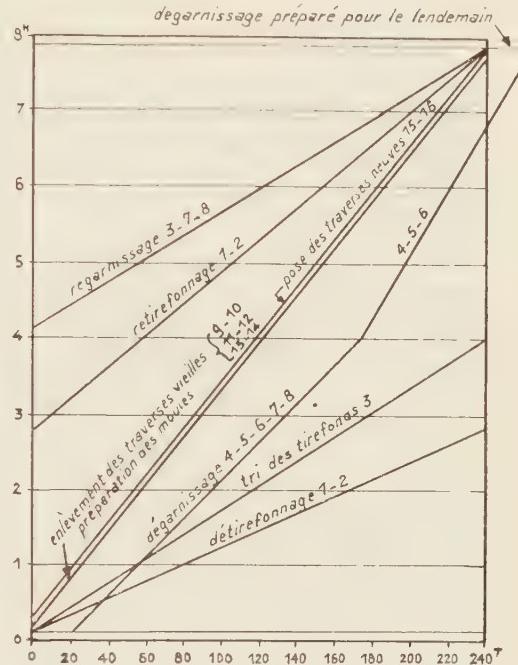


Fig. 5. — Gang of 16 men replacing sleepers with fine gravel (240 sleepers daily).

*Explanation of French terms:*

- 1-2 = tightening up coachscrews.
- 3-7-8 = finishing off.
- 9-10-11-12-13-14 = taking away the old sleepers.
- 15-16 = placing new sleepers.
- 4-5-6-7-8 = removal of fittings.
- 3 = sorting out coachscrews.
- 1-2 = unscrewing coachscrews.

This explains the different points of view expressed by the Administrations replying to this question.

S.N.C.F. — The organisation studies which led to breaking down the work into the elementary operations and the order in which they are carried out applies regardless to both manual and mechanical gangs.

The generalised application of these principles to manual gangs is therefore an excellent training for the staff in view of ulterior generalisation of mechanisation.

For example we show in the graph (fig. 12) the organisation of a manual gang

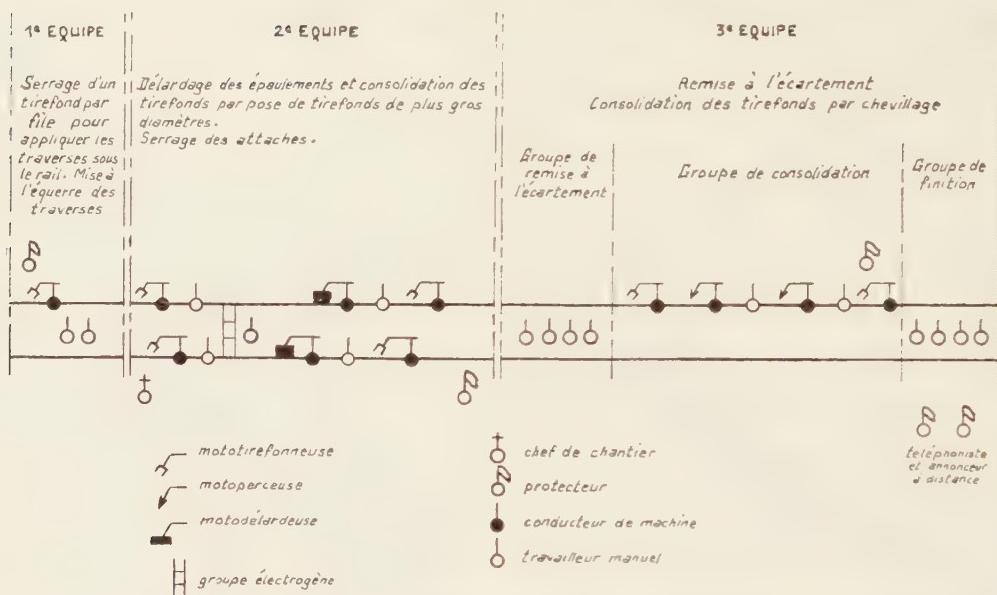


Fig. 6. — Large gang of 34 men (consolidating the fastenings, cutting and restoring the gauge).

*Explanation of French terms:*

1<sup>re</sup> équipe = 1st gang.  
Deal with one coachscrew per line to fit the sleeper under the rail. Square up the sleepers.

2<sup>de</sup> équipe = 2nd gang.  
Cut the bearing surfaces and tighten up the larger coach-screws.

3<sup>de</sup> équipe = 3rd gang.  
Correct the gauge. Tighten up the coachscrews.

Motoforegonneuse = motor coachscrewdriver. — Motoperceuse = motor drill. — Motodelardeuse = motor cutters. — Groupe électrogène = electric generating set. — Chef de chantier = foreman. — Protecteur = look-out. — Conducteur de machine = driver. — Travailleur manuel = manual worker. — Téléphoniste et annonceur à distance = distant telephone operator and look out.

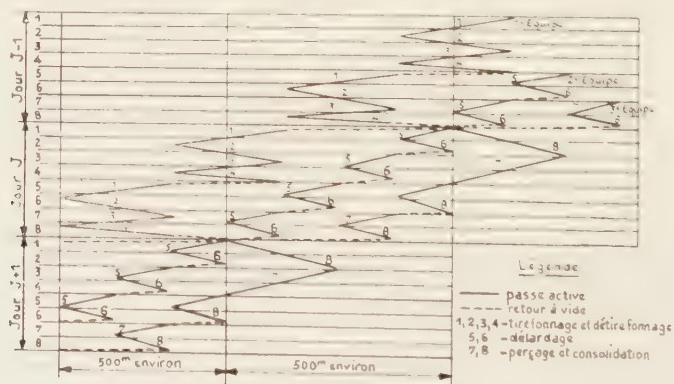


Fig. 7. — Graph showing the progress of work as above.

Legend:

- working
- return run out of work.
- 1, 2, 3, 4 = screwing and unscrewing coachscrews.
- 5, 6 = cutting.
- 7, 8 = drilling and tightening up

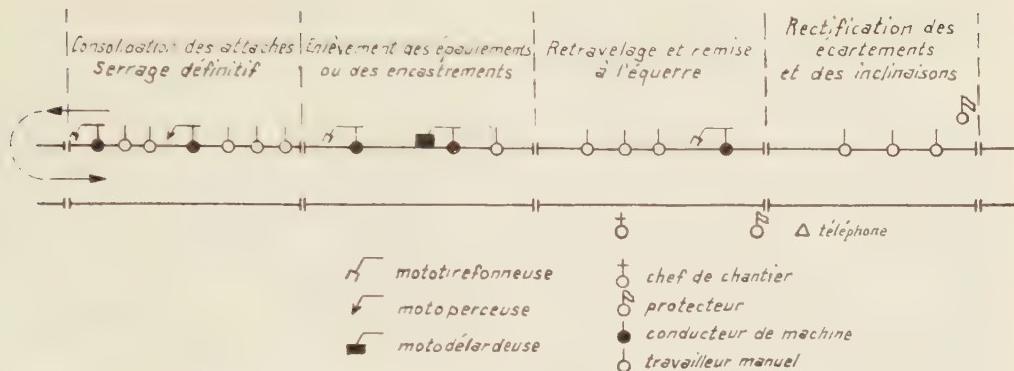


Fig. 8. — Average sized gang. Tightening up the fastenings, cutting and correcting the gauge — 20 men.

*Explanation of French terms:*

Consolidation des attaches; serrage définitif = Tightening the fastenings; final screwing up. — Enlèvement des épaulements ou des encastrements = cutting the bearing surfaces. — Retravelage et remise à l'équerre = re-sleepering and squaring off. — Rectification des écartements et des inclinaisons = correcting the gauge and cant. — Téléphone = telephone. — Mototrefonneuse = motor coachscrewdriver. — Motoperceuse = motor drill. — Motodelardeuse = motor cutter. — Chef de chantier = foreman. — Protecteur = look-out. — Conducteur de machine = driver. — Travailleur manuel = manual worker.

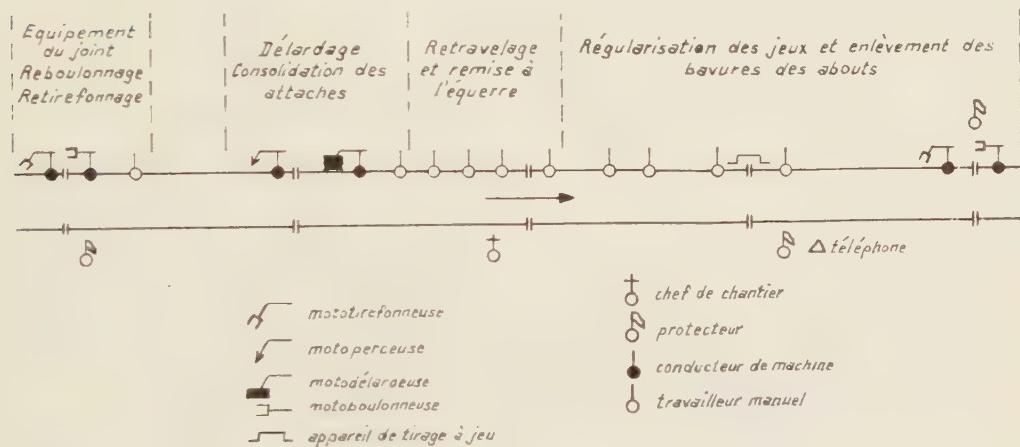
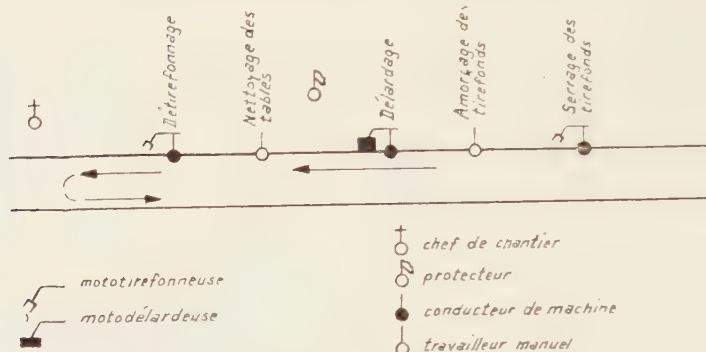


Fig. 9. — Gang dealing with the joints — 20 men.

*Explanation of French terms:*

Equipement du joint, reboulonnage, retirefondage = joint equipment; rebothscrewing. — Délardage; consolidation des attaches = cutting; tightening up the fastenings. — Retravelage et remise à l'équerre = resleepering and squaring off. — Régularisation des jeux et enlèvement des bavures des abouts = checking the play and removing any burrs. — Téléphone = telephone. Mototrefonneuse = motor coachscrewdriver. — Motoperceuse = motor drill. — Motodelardeuse = motor cutter. — Motoboulonneuse = motor bolt spanner. — Appareil de tirage à jeu = tightening up equipment. — Chef de chantier = foreman. — Protecteur = look-out. — Conducteur de machine = driver. — Travailleur manuel = manual worker.



*Explanation of French terms:*

Détirefondage = unscrewing coachscrews. — Nettoyage des tables = cleaning the bearing surface. — Délardage = cutting out. — Amorçage des tire-fonds = fitting in the coachscrews. — Serrage des tire-fonds = tightening up the coachscrews. — Mototirefonneuse = motor coachscrewdriver. — Motodelardeuse = motor cutter. — Chef de chantier = foreman. — Protecteur = look-out. — Conducteur de machine = driver. — Travailleur manuel = manual worker.

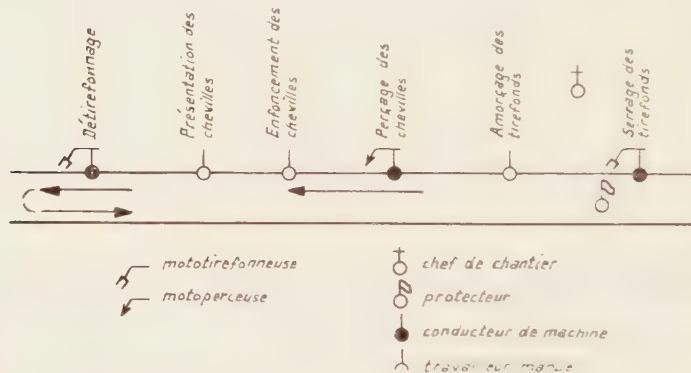


Fig. 11. — Small gang tightening up the fastenings — 8 men.

*Explanation of French terms:*

Détirefondage = unscrewing coachscrews. — Présentation des chevilles = putting in the pegs. — Enfoncement des chevilles = driving in the pegs. — Percage des chevilles = drilling the pegs. — Amorçage des tire-fonds = fitting in the coachscrews. — Serrage des tire-fonds = tightening-up the coachscrews. — Mototirefonneuse = motor coachscrewdriver. — Motodelardeuse = motor cutter. — Chef de chantier = foreman. — Protecteur = look-out. — Conducteur de machine = driver. — Travailleur manuel = manual worker.

re-cutting the bearing surfaces to enable a comparison to be made with the graphs given above relating to mechanised gangs of the same size.

This Administration adds that this could have been modified by the use of machines

designed for multiple functions, but the trials of such machines proved unsatisfactory.

*French C.F.E.* — This Administration reports that it has had to divert the following work from the gangs overhauling the

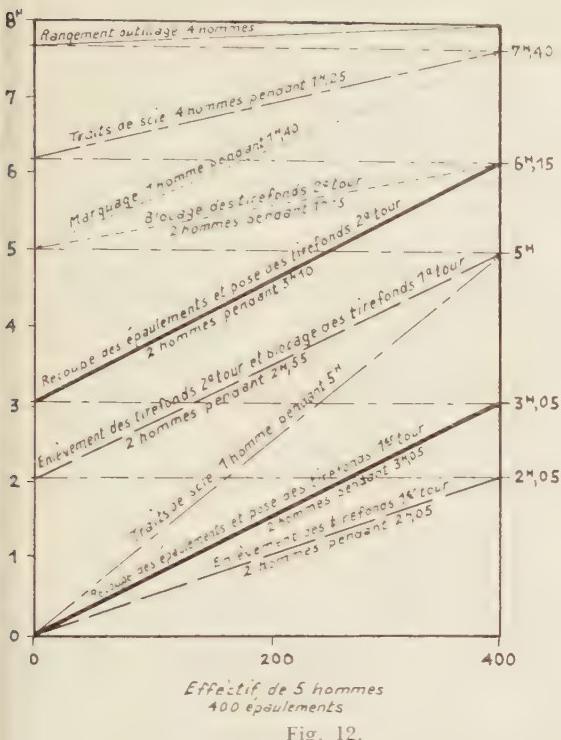


Fig. 12.

*Explanation of French terms in the same order as on the diagram:*

Laying out the work 4 men.  
 Sawing 4 men for 1 hour 25 minutes.  
 Marking out 1 man for 1 hour 40 minutes.  
 Locking the coachscrews 2nd turn — 2 men for 1 hour 15 minutes.  
 Recutting the bearing surfaces and putting in the coachscrews 2 turns — 2 men for 3 hours 10 minutes.  
 Removing the coachscrews 2nd turn and locking the coachscrews 1 turn — 2 men for 2 hours 55 minutes.  
 Sawing 1 man for 5 hours.  
 Recutting the bearing surfaces and putting in the coachscrews 1 turn — 2 men for 3 hours 05 minutes.  
 Removing the coachscrews 1st turn — 2 men for 2 hours 05 minutes.  
 5 men — 400 bearing surfaces.

fastenings so as not to hold up the progress of the motor tools :

- overhauling the track at level crossings and bridges on girders;
- regulating the play;
- checking the gauge and defects in the cant;
- inspecting the fishplates.

*Tunisian Railways.* — Report that mechanical coachscrewdrawing has become a separate operation in the overhaul to make sure the machines work to capacity.

*Moroccan Railways.* — The possibilities offered by mechanisation have enabled them to include various operations in the general overhaul (replacing rails and ballast) which if done as current maintenance would have required a much longer time, the order of the work remaining the same.

*Italian Railways.* — Mechanisation has made it necessary to perfect the phases of work in order to get a harmonious daily progress of all the different maintenance operations. This has made it possible to reduce the number of men required, apart from the men essential for maintenance on inspection and for supervision.

*Swiss Federal Rys.* — This Administration states that mechanisation encourages the development of methodical maintenance which assures a rational user of the equipment at the expense of work on inspection. This tendency moreover definitely encourages better and more economical maintenance.

#### E. — Results of mechanisation from the technical point of view.

1. *Is mechanisation of value in every case?*
2. *Should it be limited to certain types and certain conditions of the track?*

These two questions were intended to make it quite clear that the problem is not being considered from the point of view of the technique of the machines themselves. This point of view was dealt with in Mr. MUCHERIE's report <sup>(1)</sup> and the machines, apart from a few improvements in detail, have undergone very little change since then.

<sup>(1)</sup> *Railway Congress Bulletin*, Enlarged Meeting of the Permanent Commission, Lisbon, 1949 (January 1949, p. 1).

On the other hand, since the problem of the equipment has been solved, it was interesting to ascertain if the good results obtained during specially selected trials were equally valid in all cases.

*The S.N.C.F.* considers that mechanisation has a well defined field of application. This covers lines which have reached a degree of wear such that the work involved is considerable. The overhaul of the fastenings in the case of track laid without sole plates, the regularisation of the laying and the expansion gaps, continuous or partial levelling of certain types of track for which mechanical tamping is particularly suitable, appear to be the current maintenance operations in which mechanisation gives the best results.

However, mechanisation owing to the facilities it gives for carrying out the elementary work, by considerably reducing the physical effort required of the men, runs a risk of encouraging them to undertake useless work, which as far as maintenance of the track is concerned, generally wastes material or destroys the stability and is therefore harmful.

Consequently apart from the need to synchronise the elementary operations to assure the full employment of the staff and equipment, the programme must be drawn up sufficiently precisely to avoid any ambiguity about the work to be done.

*French C.F.E.* — This Administration stresses the value of mechanical cutters which do much better quality work than manual work.

Without affirming that mechanisation should be limited to certain types and certain conditions of the track, they precise that it is no longer advantageous after a certain degree of wear of the material (especially on service sidings).

*Tunisian Railways.* — It is not the big machines which are of the greatest value in maintenance work; their use can only be justified when certain operations can be grouped together and dealt with on their

own, such as systematic relaying of lines, when mechanical tampers are of value.

The standardisation and adaptation of the tools to the work required are the two determining factors.

*Franco-Ethiopian Railways.* — Mechanisation is of no value on single track lines with heavy traffic.

*Syrian Railways.* — For the time being mechanisation is of no interest on this small system owing to the low cost of labour.

*Franco-Ethiopian Railways.* — Mechanisation appears to be of interest when the type and condition of the track make it possible to count upon a satisfactory rate of progress during the interval between two trains.

*Swiss Federal Rys.* — The structure, topography, traffic and diversity of materials used for the track prevent the organisation of large working gangs to a greater extent than at present, and mean that mechanisation is not of interest in every case.

*Italian Railways.* — Mechanisation is specially interesting in the case of worn track. It is advisable in the case of track where the traffic exceeds 20 trains a day.

## PART FOUR.

### IMPORTANCE OF PATHS FOR THE MOVEMENT OF THE MEN AND MACHINES.

#### A. — Nature and position of the paths.

1. *Is it your standard practice to have paths alongside the ballast?*
2. *Characteristics of these paths :*
  - a) *width;*
  - b) *level of the path relatively to that of the rails;*
  - c) *distance of the path relatively to the rails;*
  - d) *are they outside the supporting pylons in the case of electrified lines?*

- e) is there a path on both sides in the case of double track lines?
  - f) influence of the path on the conservation of the ballast?
  - 3. When work is in hand is it possible to move about apart from the paths alongside the ballast?
  - 4. If so, what width is available?
  - 5. How are the paths taken past structures?
  - 6. Do you allow the path to be interrupted at structures?
  - 7. If so, after what span of bridge?
- B. — Machines running on the paths.**
1. What are the maximum dimensions of the machines which can be taken along these paths?
  2. What is their axle load and their load per centimetre of width of tread?
- C. — Advantages obtained by providing such paths.**
1. Has the extended provision of paths made it possible for you to reduce the time lost by the men in getting to work or getting out of the way during work?
  2. Do the advantages obtained by having paths as regards the movement of the men and machines justify their construction and upkeep alongside every line, or should they be limited to lines where the annual number of working hours per kilometre exceeds a certain figure?
  3. Has the advantages of using large machines which can be taken along these paths led you to install a special system of paths for this purpose?

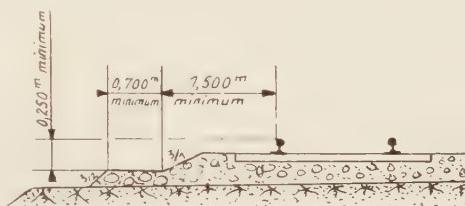


Fig. 13. — Typical profile of a track.

4. Have you any criteria enabling you to link up the cost of making and maintaining the paths with the number of working hours needed per kilometre run or tonnage carried by the line?

The replies received to all these questions are summed up in Table XI.



Fig. 14. — S.N.C.F. — Cantilever bridge to make room for a track.

## THE EXTENT OF PATHWAYS TO ALLOW

ADMINISTRATION	Is it your standard practice to have pathways alongside the line?	TYPE AND POSITION			Character
		Width	Level compared with that of the rails	Distance from the rails	
S.N.C.B.	yes	0.80	0.65	1.60	on the permanent way
OTRACO	yes permanent way extended on one side only	0.50	0.45	1.50	»
R.E.N.F.E.					No pathways
FRANCE (S.N.C.F.)	yes	0.75 minimum	0.25 minimum	1.50 minimum 1.33 on VU	inside if the rails are 2.20 m (min. 2.00 m) from the rail if not outside
FRANCE (C.F.E.)					No pathways have been systematically provided alongside the permanent way
Régie Autonome des Transports Parisiens (R.A.T.P.)					Urban system. No pathway; the minimum width of 0.70 m being for the staff.
Gafsa Railway					Sceaux Line : no pathway; the varying width is not suitable as when a train approaches.
Tunisian Railways					No. Certain pathways have been made alongside the railway but not permanent way.
Cameroons Railways	yes	0.45	0.40	1.00	»

## MOVEMENT OF STAFF AND EQUIPMENT.

### SUCH PATHWAYS

the pathways		Is there space to run on adjacent land apart from the pathways?	If so, how much room is available?	What arrangement is made for the pathways on bridges?	Is there a break in the pathway when it comes to a bridge?	If so, in the case of what span of bridge?
Is there pathway on either side in the case of double track lines?	Influence of the pathway on the conservation of the ballast					
Yes, if local conditions allow	no influence	no	»			There is a tendency to extend them over bridges
In one side only						
	»	no	»	between the track on metal bridges	no	none
A permanent way alongside it is used for going on foot or by cycle.						
In principle yes	none if it is low enough and its foundations are properly drained and on sound ground	generally no as outside the lines there are waste and cultivated lands	»	yes, on new bridges on old ones of small span concrete or metal parts are added or reinforced concrete	yes in the case of old bridges over a certain span	of more than 5 to 6 m span as a rule. There are rarely pathways on large bridges but shelters for the staff
As the staff is generally transported in trucks.						
The rolling stock gauge and structures does not generally allow of any arrangements for the circulation in presence of the catenary supports an obstacle. On bridges, notices warn the staff to get out of the danger area						
Actual		yes on certain routes	up to 20 metres	at the bottom of the Thalweg	yes, as the water courses are not permanent, the men can use the wadi way	
If can however walk along the cuttings or embankments. On certain routes, earth roads which get no						
yes	necessary for keeping in the ballast	no	»	in the centre of the track	yes	there are 1 or 2 foot paths on large metal bridge only

## THE EXTENT OF PATHWAYS TO ALLOW

ADMINISTRATION	Is it your standard practice to have pathways alongside the line?	TYPE AND POSITION				Characteristics
		Width	Level compared with that of the rails	Distance from the rails	Position in relation to the carriageway in the presence of electric lines	
<i>Franco-Ethiopian Railway . . . . .</i>	yes, space is provided	0.50 to 0.90	0.30	1.10	"	
<i>Madagascar Railways . . . . .</i>	no, foot paths	0.50	0.38	1.00	"	
<i>Moroccan Railways . . . . .</i>	no	try to have cycle pathways alongside the lines. They are obtained by improvement of the existing				
<i>Mediterranean-Niger Railways . . . . .</i>	no	There is sufficient room for all vehicles alongside the line.				
<i>Viet-Nam Railways . . . . .</i>	yes, a raised pathway on certain sections	0.50	0.30 to 0.40	1.70 to 1.8	"	
<i>Italian State Railways (F.S.) . . . . .</i>	No pathway, as geographical conditions and the relief together with economic factors do not allow for widening the bed. Pathways are however a great advantage in organization.					
<i>Luxemburg Railways . . . . .</i>	yes	0.80	0.65	1.65	"	
<i>Netherlands Railways . . . . .</i>	yes	1.00	0.40	2.30	"	outward
<i>Portuguese Railways . . . . .</i>	no, but side-space provided for safety of the staff	0.25 to 0.50	0.55	1.87 to 2.07	"	inside
<i>Swiss Federal Railways (C.F.F.) . . . . .</i>	No, it is too expensive to build pathways because of the topographical conditions. The locomotives and the rolling stock run on the line. The possibility of making pathways is being considered.					
<i>Rhaetian Railway . . . . .</i>	yes	0.25 to 0.35	0.40	1.15	"	inside
<i>Syrian Railways . . . . .</i>	yes	from 0.50 to 0.75 m wide but only on embankments for inspection tours on foot by the permanent staff of trains.				

*continued).*

## MOVEMENT OF STAFF AND EQUIPMENT.

### SUCH PATHWAYS

The pathways		Is there space to run on adjacent land apart from the pathways?	If so, how much room is available?	What arrangement is made for the pathways on bridges?	Is there a break in the pathway when it comes to a bridge?	If so, in the case of what span of bridge?
Is there pathway on either side in the case of double track lines?	Influence of the pathway on the conservation of the ballast					

V.U.	avoid the ballast spreading out	often	from 6 to 10 metres	a side passage or pathway between the rails	below 12 m
V.U.	none, pathway is on same level as permanent way	no	»	do not go across bridges or cuttings	

ible in districts where the staff use bicycles, and negotiable ways for lorries on long distance districts.  
be rolling country.

works usually on pathways.

»	holds back the ballast	yes on certain routes	varies	generally footpaths or overhanging footways	yes, when refuges can be left every 10 to 15 m
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sons have restricted the width of the permanent way. Present financial resources do not permit of work and keeping down costs.

yes	none	no	none	usually overhanging footways	only when the construction does not allow the pathway	non-
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only on one side	yes	no	»	by overhanging footways on new constructions	not if possible	»
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yes	not determined	very rarely	»	by means of footways	no	»
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the system (cuttings, tunnels, embankments, bridges, etc.) the cost of land, the catenary supports. The large special cases is not excluded.

V.U.	necessary for maintaining the ballast	no	»	at intervals	yes	»
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cuttings specially reserved for the inspector to get out of the way	yes in the plains	about 10 metres	no pathways on bridges except on a 307 m viaduct where there is a service footpath.
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THE EXTENT OF PATHWAYS TO ALLOW

		MACHINES USING THE PATHWAYS																										
ADMINISTRATION		What are the maximum dimensions of the machines which can run on the pathways?	What is the axle load of these machines and the load per cm of width of the tread?																									
<i>S.N.C.B.</i>	.....	in principle : 0.80 wide	electric generating set per axle : 250 kg per cm of tread : 42 k																									
<i>OTRACO</i>	.....	light motor cycle		»																								
<i>R.E.N.F.E.</i>	.....			No pathways																								
<i>FRANCE (S.N.C.F.)</i>	.....			the pathways are designed for the movement of bicycles and motor cycles. They are also used as much as possible for trans- porting the electric generating sets.																								
				<i>Dimensions of these sets.</i>																								
			Heavy sets : $I = 1.25$ ; $L = 2.30$ ; $H = 1.54$ wheelbase : 1.80																									
			Usual type of set : $I = 0.50$ ; $L = 2.00$ ; $H = 1.30$ wheelbase : 0.76																									
				<table border="1"> <thead> <tr> <th></th> <th>Total weight</th> <th>Axle load</th> <th>load per cm of tread</th> </tr> </thead> <tbody> <tr> <td>Bicycle and rider . . .</td> <td>130</td> <td>AV: 50</td> <td>AV: 50</td> </tr> <tr> <td>Usual type of generating set . . .</td> <td>702</td> <td>AR: 80</td> <td>AR: 80</td> </tr> <tr> <td>Heavy duty set . . .</td> <td>1 250</td> <td>351</td> <td>50</td> </tr> <tr> <td></td> <td></td> <td>AV: 250</td> <td>AV: 250</td> </tr> <tr> <td></td> <td></td> <td>AR: 1 000</td> <td>AR: 1 000</td> </tr> </tbody> </table>		Total weight	Axle load	load per cm of tread	Bicycle and rider . . .	130	AV: 50	AV: 50	Usual type of generating set . . .	702	AR: 80	AR: 80	Heavy duty set . . .	1 250	351	50			AV: 250	AV: 250			AR: 1 000	AR: 1 000
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Heavy duty set . . .	1 250	351	50																									
		AV: 250	AV: 250																									
		AR: 1 000	AR: 1 000																									
<i>FRANCE (C.F.E.)</i>	.....			No pathways have been systematically provided alongsid-																								
<i>Régie Autonome des Transports Parisiens (R.A.T.P.)</i>	.....			Urban system : no pathways; the minimum width of 0.7 m be- of the staff.																								
				Sceaux Line : no pathways; the varying width is not suitable danger area when a train approaches.																								
<i>Gafsa Railway</i>	.....			not fixed																								
<i>Tunisian Railways</i>	.....			No. The track is narrow; the staff get to work in trucks which get no maintenance can be used by lorries in good we-																								
<i>Cameroons Railways</i>	.....			forbidden																								

(continued).

## IE MOVEMENT OF STAFF AND EQUIPMENT.

### ADVANTAGES OBTAINED FROM THE EXISTENCE OF SUCH PATHWAYS

Has the provision of pathways made it possible to reduce the time lost by the men in getting to and from work or in moving from one site to another during working hours?

yes, by allowing cycles to be used

Does the advantage of having pathways for the movement of the men and equipment justify their construction and maintenance on all lines, or should they be limited to those lines on which the number of hours of work per annum exceeds a certain figure?

Has the advantage of using large machines which can travel along these pathways led you to provide a special network of pathways for this purpose?

Have you any criteria for linking up the cost of making and maintaining pathways with the annual hours of work involved or the tonnage carried by the line?

the pathway is necessary owing to the region

yes

no

no

the permanent way alongside it is used for going on foot or by cycle.

yes, as the travelling time to be paid for is fixed at 5 minutes per km by bicycle while it is 15 minutes per kilometre on foot.

these advantages are justified above all when it is a case of the staff being able to move on lines other than the long sections that have collective transport (4th category lines for which the number of working hours per kilometre of track is about 600 per annum).

no, but this will depend upon the progress of mechanisation and the policy to be applied : use of individual machines or use of machines supplied from an electric generating set..

To allow these sets to be moved about, the part of the track now unoccupied owing to the change over to single track from double track can be used.

no

permanent way, as the staff is generally transported in trucks.

the rolling stock gauge and structures does not generally allow of any arrangements for the circulation  
the presence of the catenary supports an obstacle. On bridges, notices warn the staff to get out of the

yes

according to the difficulty of making pathways and the amount of traffic.

not yet

no

yes

have to be maintained alongside all the lines for the staff and to retain the ballast.

no machines

no

T

THE EXTENT OF PATHWAYS TO ALLOW

ADMINISTRATION	MACHINES USING THE PATHWAYS	
	What are the maximum dimensions of the machines which can run on the pathways?	What is the axle load of these machines and the load per cm of width of the tread?
<i>Franco-Ethiopian Railway</i> . . . . .	no machines are allowed to run alongside the pathway in principle	
<i>Madagascar Railways</i> . . . . .	the machines cannot use them	
<i>Moroccan Railways</i> . . . . .	Gang lorries $l = 2.22; L = 6.15; H = 2.98$ Weight loaded : 7 264 kg	
<i>Mediterranean-Niger Railways</i> . . . . .	There is sufficient room for all vehicles alongside the	
<i>Viet-Nam Railways</i> . . . . .	bicycles	»
<i>Italian State Railways (F.S.)</i> . . . . .	No, pathways as geographical conditions and the relief together permit of widening the bed. Pathways are however a great adv	
<i>Luxemburg Railways</i> . . . . .	no machines allowed	
<i>Netherlands Railways</i> . . . . .	reserved for the staff	
<i>Portuguese Railways</i> . . . . .	no machines for maintaining the lines	
<i>Swiss Federal Railways (C.F.F.)</i> . . . . .	No, it is too expensive to build pathways because of the topo large machines run on the line. The possibility of making pa	
<i>Rhaetian Railways</i> . . . . .	no machines on the pathways	
<i>Syrian Railways</i> . . . . .	no machines on the pathways	

II (continued).

## THE MOVEMENT OF STAFF AND EQUIPMENT.

### ADVANTAGES OBTAINED FROM THE EXISTENCE OF SUCH PATHWAYS

Has the provision of pathways made it possible to reduce the time lost by the men in getting to and from work or in moving from one site to another during working hours?	Does the advantage of having pathways for the movement of the men and equipment justify their construction and maintenance on all lines, or should they be limited to those lines on which the number of hours of work per annum exceeds a certain figure?	Has the advantage of using large machines which can travel along these pathways led you to provide a special network of pathways for this purpose?	Have you any criteria for linking up the cost of making and maintaining pathways with the annual hours of work involved or the tonnage carried by the line?
---	--	--	---

has no influence | no | no | no

the pathways are only paths alongside the line for the staff; they are so close to the rails that the staff have to stand aside when a train passes.

yes | yes for long sections where lorries are used the pathways must be maintained. | no | no

sually on pathways.

this question does not arise for the moment as the gangs are transported collectively in staff trains.

economic reasons have restricted the width of the permanent way in organising the work and keeping down costs.

yes | yes | no | no

yes | yes | no | no

although the men travel by truck, pathways alongside the permanent way are very useful. They are included in all profiles independently of the category of the line.

of the system (cuttings, tunnels, embankments, bridges, etc.) the cost of land, the catenary supports. The in special cases is not excluded.

there have always been pathways alongside the ballast are justified in every case. | no | no

The creation of pathways is of no value on this system owing to its geographical situation.

The following conclusions can be deduced :

— In the case of European Railways, pathways alongside the ballasted track exist in a great many cases. Only the Swiss Federal and Italian Railways have no such pathways as the geographical situation of their systems for economic reasons has limited the width of the track to that strictly necessary; but these two Administrations do not exclude the possibility of providing such pathways in the future to the extent their finances make possible.

— In the case of overseas railways, the need for pathways is not generally so important in view of the possibility of using the adjacent land for traffic, even lorries. Moreover certain railways who replied in the affirmative to the above question are considering building special pathways alongside their lines.

## PART FIVE.

### ECONOMIC AND FINANCIAL ASPECT.

#### A. — Evolution of the amount of labour devoted to maintenance.

*1. With the present organisation of your railway, what is the annual number of hours per kilometre of track devoted to the work given in the table below (Appendix II) :*

- a) *for the lines with the heaviest traffic;*
- b) *for the lines with the least traffic?*

To enable a comparison to be made of the figures received, we asked the Administrations to state the category of line covered by the replies according to the following classification (¹) :

If characterising a line by the daily tonnage carried (the output of the line would be the number of tons circulating in both

(¹) The category of line is referred to again in Appendix II under the name of the Administration concerned.

directions during 24 hours at any given point on the line) a line would be called :

— very important : where the daily tonnage per track (¹) is equal to or exceeds 40 000 tons;

— important : where the daily tonnage per track (¹) lies between 40 000 and 20 000 tons;

— average : where the daily tonnage per track (¹) lies between 20 000 and 8 000 tons;

— of little importance : where the daily tonnage per track (¹) is less than 8 000 tons.

#### 2. Is this number of hours sufficient to assure satisfactory maintenance ?

Most of the replies received were in the affirmative. In addition, the Tunisian Railways advised us that they have some excess staff to absorb owing to the modernisation of their maintenance methods; about 20 % should be deducted from the present staff to give a true idea of the amount of labour really required for the maintenance of their lines.

On the other hand, the following Administrations replied in the negative :

*French C.F.E.* — The labour force available is insufficient on lines where the material is badly worn, those suffering are the consequences of arrears of maintenance, and those where the condition of the bed necessitates frequent overhauls.

*Madagascar Rys.* — The labour available would be sufficient if the age of the track did not necessitate many heavy repairs.

*Italian Rys.* — The labour force is insufficient for proper systematic maintenance, and owing to this fact the work is contracted out to private firms.

*Netherlands Rys.* — Private firms have still to be called in to carry out general overhauls.

(¹) For a line with several tracks, the daily tonnage of a track is equal to the quotient of the daily tonnage of the line by the number of tracks.

TABLE XII.

	<b>No. of hours worked per km of line by the maintenance gangs.</b>				
	<i>Belgian Rys. (S.N.C.B.)</i> (9 863)	<i>French Rys. (S.N.C.F.)</i> (8 109)	<i>French C.F.E.</i> (396)	<i>Tunisian Rys.</i> (1 712)	<i>Swiss Rys. (C.F.F.)</i> (11 644)
1920 . . . . .	»	2 620 h.	»	»	»
1925 . . . . .	»	»	970	»	»
1928 . . . . .	4 545 h.	»	»	»	»
1929 . . . . .	4 420	»	»	»	»
1930 . . . . .	4 415	2 400	730	»	»
1931 . . . . .	4 217	»	»	»	1 440
1932 . . . . .	3 881	»	»	»	1 340
1933 . . . . .	3 305	»	»	»	1 270
1934 . . . . .	3 432	»	»	»	1 230
1935 . . . . .	3 160	»	»	»	1 210
1936 . . . . .	3 143	»	»	1 037	1 240
1937 . . . . .	3 247	»	»	»	1 215
1938 . . . . .	2 658	»	»	»	1 250
1939 . . . . .	2 522	2 300	»	»	1 195
1940 . . . . .	{ unknown	»	»	»	1 380
1941 . . . . .		»	»	»	1 670
1942 . . . . .	2 329	»	»	»	1 820
1943 . . . . .	2 592	»	»	»	1 780
1944 . . . . .	1 879	»	»	»	1 750
1945 . . . . .	2 690	»	»	»	1 790
1946 . . . . .	2 992	»	»	»	1 640
1947 . . . . .	2 672	»	»	»	1 450
1948 . . . . .	2 757	»	»	830	1 500
1949 . . . . .	2 691	»	680	»	1 480
1950 . . . . .	2 457	»	»	»	1 470
1951 . . . . .	2 558	2 010	»	656	1 425
1952 . . . . .	»	1 970	560	»	»

*Portuguese Rys.* — The labour force available would be sufficient if the work of renewal was not in arrears.

*Syrian Rys.* — The labour force available is sufficient for the moment, but would need increasing were the traffic to become heavy.

3. *Have you any statistics showing the evolution of the number of hours per kilometre of line by the permanent way gangs during the last 25 years, for all the operations for which these gangs are responsible?*

Five Administrations replied to this ques-

tion. The data supplied are summed up in Table XII.

The figures in parentheses under the name of the Administrations give the average daily tonnage per km of main line.

4. *Please fill in, if possible, the tables of Appendix III, relative to the average real expenditure per annum on the permanent way, in the currency of your country and converted in American Dollars — and also to the total annual expenditure you consider necessary in order to assure suitable maintenance from the point of view of safety for the whole of your system.*

Five Administrations were not able to supply the information required about the annual cost, either because they do not get out any statistics, or because such statistics would give a false picture owing to the exceptional amount of work required after the war.

To lighten Appendix III we have only given the costs in U.S.A. dollars, using the current rate of conversion.

In addition, to facilitate comparisons, we have shown in italics under each cost figure, the value per km of track, using as divisor the size of the railway as given in table A-2.

It should be noted that as the wages and charges on salaries differ very considerably from railway to railway, the labour costs per km are not in the same ratio as the number of hours given in Appendix II, even in the case of lines of equal importance.

These differences are still more marked in the case of the total costs.

#### *French C.F.E.*

Approximate portion of the costs attributable to :	Manual gangs	Mechanised gangs
a) labour . . . . .	45 <sup>o</sup> <sub>o</sub>	37 <sup>o</sup> <sub>o</sub>
b) materials . . . . .	53 <sup>o</sup> <sub>o</sub>	58 <sup>o</sup> <sub>o</sub>
c) equipment . . . . .	1 <sup>o</sup> <sub>o</sub>	3 <sup>o</sup> <sub>o</sub>
d) fuel . . . . .	1 <sup>o</sup> <sub>o</sub>	2 <sup>o</sup> <sub>o</sub>
Percentage of reduction in the costs :		
of labour . . . . .		24 <sup>o</sup> <sub>o</sub>
as a whole . . . . .		9 <sup>o</sup> <sub>o</sub>

#### *Italian State Railways.*

Expenditure attributable to :	Cost in lire and %			
	Manual gangs		Mechanised gangs	
a) labour . . . . .	440 L.	49 %	260 L.	33 %
b) materials . . . . .	400 L.	44 %	400 L.	50 %
c) equipment . . . . .	40 L.	5 %	100 L.	13.5 %
d) fuel . . . . .	15 L.	2 %	25 L.	3.5 %
Saving obtained by mechanisation :				
on labour . . . . .				about 25.5 %
on total costs . . . . .				about 14 %

*Swiss Federal Railways.*

Time spent and cost in Swiss francs per metre of track tamped and fastenings tightened up as carried out mechanically and manually.

	Manual work		Mechanical work		
	Time	Cost	Time	Cost	Saving %
Tamping sleepers 1 to 5 cm . . . . .	h 0.80	fr. 3.60	h 0.40	fr. 1.80	50 %
Maintenance and sinking fund charges for the machines . . . . .	»	»	»	1.60	
Total . . . . .		3.60 —		3.40 —	6 %
Tightening up fastenings (complete fastening) . . . . .	0.10	0.45	0.02	0.09	80 %
Maintenance and sinking fund charges for the machines . . . . .	»	»	»	0.11	
Total . . . . .		0.45		0.20	55 %

*S.N.C.F.*

The reply received from this Administration enables a comparison to be made :

a) between a manual gang and various types of mechanised gangs carrying out the same work (Table XIII).

b) between two gangs of the same size overhauling material in cases where the relative parts of the elementary work differ very considerably (Table XIV).

A) Consolidating the fastenings, recutting the sleepers and correcting the gauge by different mechanised gangs (Table XIII hereafter).

An examination of this table shows that the advantage of the greater productivity of a large mechanised gang (saving of 56 % in labour compared with manual labour) is swallowed up to a large extent by the travelling expenses that have to be paid to the men and the cost of their living-train;

the final saving is not more than 10 % of the total costs compared with a manual gang.

As for the small mechanised gang, its costs are burdened by :

1) the cost of keeping a permanent lookout to warn the men of trains on the track in question and on the adjoining track and protection for about 75 % of the working time;

2) the need to repeat certain elementary operations several times, these being common to the different phases of the work but the small size of the gang making it necessary to separate them.

The average sized gang obtained by amalgamating 2 or 3 local gangs saves the high cost of travelling expenses and a living train and justifies to a greater extent the cost of protection and keeping a look out which is no greater than in the case of a small gang.

TABLE XIII.

	Mechanised gangs				Manual gangs of 8 men	
	of 34 men living in a staff train	of 20 men	of 8.75 men	Costs (1)	Costs (1)	%
Wages,	102 000	51	117 000	65.7	135 000	70
Labour }	26 000	13	4 000	2.3	>	>
Maintenance and sinking fund charges for the staff train	14 000	7	>	>	>	>
Permanent way materials	36 000	18	36 000	20.2	36 000	19
Tools,	10 000	5	10 000	5.6	10 000	5
Fuel	8 000	4	8 000	4.5	8 000	4
Laying and removing the temporary telephone lines	4 000	2	3 000	1.7	3 000	2
	200 000		178 000		192 000	
Time required in days				88 d.	92 d.	102 d.
Daily individual				11.37 m	10.87 m	9.8 m
Daily output total				386 m	216 m	86 m
						220 000
						155 d.
						6.45 m
						51.60 m

(1) All costs based on 1949 rates.

TABLE XIV.

	Working site A			Working site B		
	Mechanised gang of 8.75 men (1)	Manual gang of 7 men	Mechanised gang of 8.75 men (1)	Manual gang of 7 men	Costs (2)	%
Labour . . . . .	Costs (2)	" "	Costs (2)	" "	Costs (2)	%
	89 000	80	133 000	90	35 000	82
Permanent way materials . . . . .	10 000	9	10 000	7	1 500	3.5
Tools . . . . .	6 000	5.4	4 000	3	1 500	3.5
Fuel . . . . .	3 000	2.8	" "		2 000	4
Laying and removing temporary telephone lines . . . . .	3 000	2.8	" "		3 000	7
	<u>111 000</u>		<u>147 000</u>		<u>43 000</u>	<u>47 000</u>
Time required in days . . . . .	45 d.		76 d.		18 d.	26 d.
Daily rate { individual . . . . .	17.6 m		13.0 m		44 m	38 m
of progress { total . . . . .	154 m		91 m		385 m	266 m

(1) — 0.75 men required for protective duties.

(2) Cost per km of lines dealt with in 1951.

In addition, they can be so organised that repetition of the elementary work is avoided.

B) Work carried out on flat bottomed rails laid on 1722 sleepers per km (Table XIV above).

	% of the section
Working site A :	
fastening up the fastenings . . .	100
recutting the bearing surfaces . .	60
tightening up the coachscrews . .	25
Working site B :	
fastening up the fastenings . . .	100
recutting the bearing surfaces . .	10
tightening up the coachscrews . .	4

Whereas the saving on the total cost is 25 % when a large number of bearing surfaces and fastenings have to be dealt with, it falls to 8 % as soon as the number is reduced. This table confirms that in order to be of value mechanisation must be used on sections where a large quantity of work is required.

## 2. How much of the labour costs in each case are due to the cost of protecting the work?

Very few Administrations supplied the information asked for, some of them considering such costs insignificant.

The two replies received were as follows :

S.N.C.F.

### a) Large mechanised gangs.

Minimum :

1 telephone operator;

1 look-out;

1 guard:

i.e. 3 men for about 30 men, i.e. 10 % of the labour costs, to which must be added the 2 or 3 % of the cost of laying and removing the telephone equipment.

In reality the cost is often greater as the length of the working sites nearly always

makes it necessary to have additional look-outs to warn the different groups of labourers when the look-out gives his warning, so that the protection required may constitute in fact 15 to 20 % of the total labour.

### b) Small mechanised gangs.

As already stated in the third part B-4, a look-out is required when the visibility is not sufficient to allow of time to remove the machines from the track; about 75 % of the lines come under this category.

The balance-sheets therefore must make allowance for 1 look-out and 0.75 guards, i.e. 1 man 75 for 9 men, or about 19 % of the labour costs, plus 2 to 3 % for the cost of laying and removing the telephone equipment when this is required.

### c) Average sized mechanised gangs.

The safety arrangements are generally the same as in the case of the small mechanised gangs, i.e. a permanent look-out and a guard for 75 % of the lines dealt with, i.e. 1 man 75 for about 20 men, representing 8.5 % of the labour costs, to which must be added about 1.5 % for laying and removing the telephone equipment.

### d) Manual gangs.

In view of the absence of noise and lightness of the equipment each platelayer is using, protection is only necessary when the visibility is very bad, which is not often the case, and can be taken as about 30 %, i.e. 0.33 for a total of 8 men, representing about 4 % of the labour costs.

### Italian Railways.

Expressed in lire, the cost of protection per metre of track amounts to :

- 12 lire for manual work;
- 16 lire for mechanical work.

Referring to the figures supplied by this railway under B-1 above, the costs represent the following percentages of the labour costs :

- |                             |       |
|-----------------------------|-------|
| — manual work . . . . .     | 5.5 % |
| — mechanised work . . . . . | 12 %  |

*3. How much of the labour costs are attributable to unproductive time :*

- a) *while the men wait for trains to pass?*
- b) *for moving equipment, etc.?*

*S.N.C.F.* — In the case of large mechanised gangs, the time lost represents about 15 % and the time taken to deal with the equipment (taking it off the line and putting it back) about 7 %.

For small mechanised gangs, the time lost is about 5 % and the time taken to move the equipment about 5 % also.

For average mechanised gangs, the time lost represents about 5 % and the time taken to move the equipment is also about 5 %.

In the case of manual gangs, the time lost is about 2 % and 1 % for moving the equipment.

The percentages refer to a traffic of about 8 to 10 trains during the time of work.

On certain large arteries with very heavy traffic, the time lost is much greater : it may be about 13 % on the open line and as much as 35 to 40 % in the suburbs where there are more than 2 tracks; such figures mean that the work must be done at night on lines where the service is suspended during part of the night.

*Tunisian Railways.* — Without giving the percentage, the Tunisian Railways give the following figures for time lost :

— morning and evening : 10 minutes for stopping work and packing up;

— for each train : 1 1/2 minutes, i.e. 15 minutes for the average of 10 trains passing during working hours.

*Cameroons Railways.* — Estimate the loss of time for the whole of the railway to be 18 hours per day and train. Referring to the hours spent on maintenance as given in Appendix II (about 6 000 hours per day) this means a loss of 0.3 % per train.

*Madagascar Railways.* — Per gang per week :

- 10 minutes for getting off the line (day railcar);
- 1 hour for moving the equipment.

*Netherlands Railways.* — The average percentages which may vary with the number of trains are :

- 10 % for getting the men off the line;
- 10 % for removing the equipment.

*4. How much do the transport costs amount to (time lost on the journey — driving the transport vehicles taking the men to the place of work in the case of large gangs — amortisation and maintenance of the transport vehicles)?*

*5. How much additional cost is involved when a gang has to work away from its headquarters?*

*6. Is the normal wage raised because of this?*

As we saw in the First Part — Question B-2 c — the work of gangs at a distance from their homes involves supplementary costs for the railways :

1) a reduction in the actual working time, the journey time counting as part of the daily working hours, or being made up for by additional time off when the working hours are not reduced;

2) the sinking fund, maintenance, fuel and staff costs of the transport vehicles : lorries or trucks;

3) additional money payments to the staff to compensate them for the additional travelling involved.

The additional cost for the railway is therefore considerably more than the nominal increase in the staff wages.

We give hereafter (Table XV) the figures supplied by various Administrations showing the amount of such charges compared with the normal maintenance costs.

TABLE XV.

Administration	Amount of transport costs in the case of large gangs.	Supplementary costs when a gang works at a distance from its centre	Increase in the standard wage
<i>S.N.C.F. . . . .</i>	Gangs nearly always lodged in trains standing close to the site of work.  Travelling time returned on the average $\frac{1}{2}$ hour daily : 6% sinking.  Fund and maintenance of staff trains : 7%  Travelling allowances: 15% Or some 40% of the labour costs.	Travelling allowances 1st month — married man : 840 fr. per day; single man : 710 fr. per day.  After first month — married man : 710 fr. single man : 500 fr.	65 % to 55 %
<i>French C.F.E. . . . .</i>	Of the order of 5%.	No other expenditure than the cost of transport.	no
<i>R.A.T.P. . . . .</i>	8% of the working time (travelling by regular trains).	no	no
<i>Algerian Railways. . . .</i>	Has no effect on hours of work — driving transport machine : 3.5%.	Travelling allowance.	ye;
<i>Tunisian Railways. . . .</i>	13 000 days for a labour force of 1 060 men in 1937 fell to 1 200 days for 742 men in 1951, or 5.3%.  This Administration considers however that if the men have to work more than 40 km (25 miles) away from their centre it is better to adopt some solution doing away with transport which will lead to a loss of time on certain runs.  It is better to set up a seasonal gang formed of a nucleus of permanent staff with temporary staff recruited locally.		»

TABLE XV. (*continued*).

Administration	Amount of transport costs in the case of large gangs	Supplementary costs when a gang works at a distance from its centre	Increase in the standard wage
<i>Tunisian Railways (continued)</i>	Maintenance costs and the fuel consumption of the transport vehicles per year per section are : trolley : 480 000 fr. lorry : 1 000 000 fr.		
<i>Madagascar Railway . . .</i>	About 10 %.	Travelling allowance of the order of 20 % of the gross wage.	no
<i>Mediterranean-Niger Railway</i>	Transport does not reduce the working time. The sinking fund and maintenance costs of the lorries represent some 2 800 000 fr. per year, 3.5 % of the maintenance budget.	none	no
<i>Italian Railways (F.S.) . . .</i>	About 10 lire per metre of track for 260 lire labour costs on double track line, i.e. 7 % approx.	Hourly allowance of 64 lires.	kept apart
<i>Netherlands Railways . . .</i>	15 % of the time.	Supplement of 1.25 or 125 fr. when the man is working more than 3 km from his section.	no
<i>Swiss Federal Railways (C.F.F.) . . . . .</i>	The additional time due to the journey, on the average 25 minutes, is included in the working time.	Allowance for midday meals taken in refreshment vans belonging to the Administration.	"
<i>Rhaetian Railway . . . . .</i>	"	Allowance of 1 Swiss fr. for the midday meal.	no
<i>Syrian Railways . . . . .</i>	1 hour for travelling per gang or 7 men.	Travelling allowance of 50 % of the normal fare (very rare).	no

*7. Have you any data to show the increase in the cost of maintenance per kilometre in terms of the age of the track?*

Only three Administrations replied to this question. We give their answers below.

*French C.F.E.* — Did not give any figures but estimate that variations in the amount

of traffic (tonnage, load per axle, wheel-base of vehicles on curves) have a greater effect than the ageing of the track.

*Madagascar Railways.* — Did not give any actual figures, but think that it can be admitted that the cost of maintaining a worn line compared with a new line is about double.

*S.N.C.F.* — The data are theoretical and given merely for information.

	Lines of		
	1st Category A	1st Category B	2nd Category
During the first 10 years after renewal:			
— labour . . . . .	456 700	428 000	369 600
— ballast . . . . .	30 000	24 000	18 000
	486 700	452 000	387 600
After the first 10 years :			
— labour . . . . .	456 700	428 700	369 600
— ballast and materials. . . . .	360 000	318 500	186 150
	816 700	747 200	555 750

## PART SIX.

### A. — The opinions of the Administrations on the results of the evolution now taking place.

At the end of the Questionnaire we asked :

*Have methodical organisation of the work and in particular mechanisation enabled you to improve the quality of the work and reduce maintenance costs to such an extent that the time between two systematic renewals can be appreciably extended?*

The change in the maintenance methods on most railways has only just passed the

trial stage, so that generally speaking they have expressed their hopes rather than any affirmations supported by figures regarding the improvement in the quality of the work and the reduction in costs.

Moreover, the troubled times through which we have passed have so upset the normal carrying out of renewal work that it is impossible to generalise; at the present time renewals justified by an economic comparison between the amortisation of the new material and the cost of laying it and the cost of maintaining a track which has reached a certain degree of fatigue.

However here again the Administrations hope that the new maintenance methods will give positive results.

**B. — Certain factors whose influence on the evolution of maintenance methods may prove predominant in the future.**

The question on the agenda is concerned essentially with the evolution of the organisation of permanent way maintenance, so that the replies received from the Administrations centred on the efforts made to rationalise an operation which had long retained an empirical character and which depended chiefly on the gang foreman for the way it was carried out.

Studies carried out with such a rationalisation in view also showed the saving which could be obtained by changes in the design of the material and an improvement in its quality making it possible to space the periodic overhauls at wider intervals whilst reducing the amount of work required between them.

Two components appear essential in this connection : the joint and the sleepers.

*1. The joint.*

The joint leads to maintenance costs both on account of the fact that it is a weak point and owing to the vibrations which the shocks it causes sets up for the track as a whole, the action of such vibrations being just as harmful on the material factors as on the qualitative factors of the latter.

The attempts made by the Administrations to combat the harmful effects of the joints have followed three different courses :

— the *first* endeavours to reduce the harmful effects of the joints in old tracks where a certain deformation of the ends of the rails occurs together with a faulty level of the ends of the two lines of rails.

It has long been the practice to remedy this in part by the use of specially machined fishplates, the upper part of which is slightly raised at the centre and around the joints, but such a remedy does not correct the crushing of the end of the upper rail which is particularly noticeable on rails

manufactured of steel with a low carbon content.

The development of the technique of building up the end of rails by electric welding using self-contained electric generating sets now makes it possible to restore the running surface at joints to the same level on the two rails, at the same time giving the ends built up in this way a degree of hardness which makes them much better able to resist the shocks of the wheels. The cost of the whole operation (materials and labour) is little more than the cost of two hours of a plate-layer's time, and can be done without difficulty no matter how heavy the traffic on the line.

A recent trial over several hundred kilometres enabled us to restore rails 17 years old, manufactured of insufficiently hard steel to running conditions at the joints just as good as those obtained with new material.

— the *second* is to endeavour to reduce the number of joints by using longer and longer rails, either by laying long rails or welding a certain number of rails together (<sup>1</sup>). The use of this method is however only possible in countries where the restrictive regulations requiring the joint gap to be proportional to the length of the rail are no longer enforced, experience having proved that after 12 m (39 ft.) this expansion rule was completely false in the case of rails fastened to the sleepers in the usual fashion. Belgium, Italy, Switzerland, Algeria, Portugal, Holland, Gafsa, OTRACO, Rhaetian Ry., Cameroons, West Africa, Tunisia, Luxemburg report using rails 25 m (82 ft.) long and over.

— the *third* is based on the complete suppression of joints, not only in tunnels and on viaducts but also on the open track when this is laid on the straight or in curves of sufficiently large radius.

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(<sup>1</sup>) The latter operation to be profitable requires however relatively long intervals between trains.

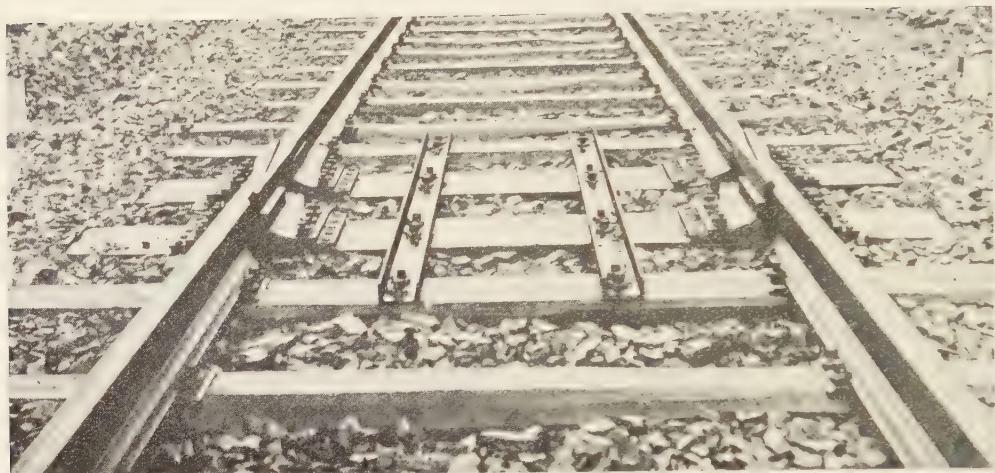
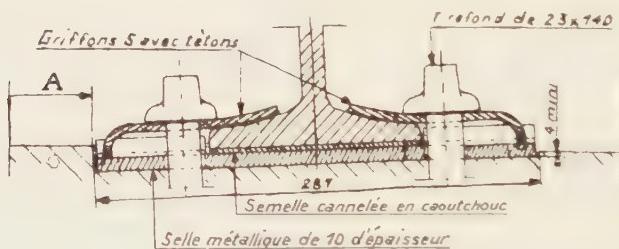


Fig. 15. — Expansion device.

VOIE EN RAILS 50 kg (U-36)

## POSE AVEC SELLE



## POSE SANS SELLE

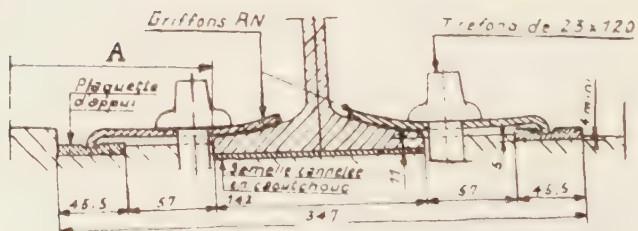


Fig. 16. — U.36 rails (50 kg [110 lbs.]). Elastic fastenings.

Explanation of French terms:

Pose avec selle = laid with bearing plate. — Griffons = clips. — Tire-fond = coachscrew. — Semelle cannelée en caoutchouc = ribbed rubber pad. — Selle métallique de 10 d'épaisseur = metal bearing plate, thickness 10. — Pose sans selle = laid without bearing plate. — Plaquette d'appui = bearing pad.

The rails are laid in lengths of several hundred metres (usually 800 m [2 624 ft.]) connected by expansion devices of simple design (fig. 15). This solution has been largely developed by the S.N.C.F. where the length laid between 1949 and 1952 has reached 287 km (178 miles), the programme for 1953 being 444 km (276 miles). Laying long rails in this way is combined with the use of special elastic fastenings (fig. 16) which reduce the fatigue of sleepers and act at one and the same time as fastenings and anti-creep devices.

Without going into the results expected as regards the conservation of the material, quite apart from the present saving in fish-plates, as this method is still in its infancy, it may be stated that from the point of view of the level the saving will be very great since the sections already laid have required practically no maintenance, although some of them are on heavily loaded lines or lines run over at speed.

## *2. The sleepers.*

A large part of the maintenance costs (material and labour) in the periodic overhauls is due to the replacement or consolidation of the sleepers which are no longer fulfilling their functions owing to age or wear. If the life of the sleepers can be increased and the behaviour of the fastenings improved, the period between overhauls can be increased.

Studies on improving the sleeper characteristics by the use of metal and concrete have been essentially based on this idea.

Wooden sleepers can also benefit by the improvements intended to increase their useful life.

Fastening the rail by means of strongly elastic fastenings and the use of large sole plates can considerably reduce mechanical wear.

The perfecting of economic methods of coating the upper surface of the sleepers makes it possible to protect them effectively against the harmful consequences of alternating dryness and humidity, particularly

noticeable since it has become the general practice to lay them uncovered. In addition, new methods of impregnation are being studied. These are intended to make it possible to avoid long drying out in the open which is the cause of internal stresses which facilitate the future development of cracks in the sleepers.

Considerable progress is therefore to be expected in reducing the stresses on the track and increasing the life of certain components. It must not however be forgotten that such progress will only lead to economies in so far as the simplicity of design of the track is safeguarded and provided they do not imply using new components which will wear more rapidly than the main components involving additional inspection and replacement between cycles which it was hoped to eliminate.

## C. — The importance of the management of labour.

Trials of the new organisation has hitherto been carried out not only under favourable technical conditions but also under the supervision of foremen selected for their special aptitude.

These methods would therefore have to be adapted before their general application under less exceptional conditions. In spite of such an adaptation, this generalisation would not be successful unless those responsible for managing the labour understand fully well the very important part they play in the search for new economies.

This is just as important an evolution as that achieved some thirty years ago when quality maintenance was first introduced. At that time, the maintenance ceased to be the responsibility of the gang foremen alone. The managerial staff began to devote a great deal of their time to it, and thanks to the part they have since played in the organisation of the work, the application of more precise methods and the wise use of working hours, brilliant results have been achieved, together with an ever

increasing reduction in labour requirements.

If we are to go any further in making savings in labour and materials, whilst maintaining the different categories of lines at the desired level, a new stage becomes necessary.

As the report shows, the question of organisation is primordial and the five rules :

— foresee, organise, co-ordinate, direct, check  
must be applied ever more thoroughly, not only to the general problems but to those arising in the course of the work itself.

There can be no question of leaving this responsibility to the gang foremen, who have not the necessary technical knowledge or training and would only be hindered thereby in their essential role of guide and overseer. Nor can it be left to the higher grades of officials whose duties are too extensive for them to be able to make the necessary analyses directly and thoroughly. This study of the details, in which they may well lose their way, is not their mission, but it is for them to design the materials, to give the general directives, to study the organisation as a whole and to provide suitable training for those directly responsible for the application of the best methods for carrying out the work.

It is therefore up to the management to take the necessary steps as regards the preparation, supervision and control of the programme, paying the same attention to the economic side as has been given to date to the quality of the work.

This, the normal development of the present functions of the management, will involve more frequent contact with the men responsible for carrying out the work. This will be facilitated by the regrouping of the men into a smaller number of gangs, when there are no reasons why this should not be done.

### RÉSUMÉ AND SUMMARIES.

I. — a) With ever increasing competition, the Railway Administrations are

endeavouring to reduce as much as possible the cost of maintaining the permanent way whilst at the same time running heavier and faster traffic over most of the lines with increased safety and comfort.

Although a very considerable reduction in maintenance costs (especially from the point of view of labour) has been achieved during the last thirty years, this evolution is not yet complete and it should be possible to make further savings.

The various Administrations find themselves in very different positions from many points of view (geographical situation, traffic gangs of platelayers, possibility of getting men, labour charges, etc.). The present maintenance methods show considerable differences and the studies in hand to improve them are strongly influenced by the actual position.

b) Permanent way maintenance gangs in general in addition to the actual maintenance are responsible for inspection (regular tours of inspection to check the state of the line, exceptional inspections after storms, greasing the points and switches) and have to replace level crossing staff and staff at posts on the open line.

The resulting cost of inspection obligations and the existence of level crossings with keepers is masked in many countries by accommodation difficulties in the large towns which makes it necessary to leave the staff dispersed in the small houses built at the same time as the railway for level crossing keepers. This cost however becomes the greater the further away we get from the classic organisation into small gangs of platelayers dispersed along the line. It should be reduced both by the improvements made to the material and equipment and by general measures (reduction in the number of level crossings with keepers for example). However there will have to be priority inspection at certain geographical situations, which will thus burden indirectly the maintenance costs.

c) Although there are differences in the studies in hand, in every case we find the same components, the effects of which vary

according to the particular characteristics of the railway in question :

— some endeavour to increase productivity by concentrating the staff in relatively large gangs, equipped with transport vehicles;

— others tend to increase individual productivity by using motor tools enabling one man to do a larger amount of work more easily.

Such studies relate most often to limited sections and have the character of trials. However certain Administrations state that their programme of concentration has now been realised.

As for mechanisation, the smallness of the ratio between the equipment in H.P. and the total number of men shows that such a development is still very limited (<sup>1</sup>).

II. — After recognising the insufficiency of the « stitch in time » method for assuring the proper condition of the permanent way, certain railways have adopted a general overhaul method covering the whole system, which is unnecessarily costly.

The introduction of methodical maintenance covering a periodic general overhaul and a limited overhaul to deal with the level and tightening up the fastenings has resulted in considerable savings, especially from the labour point of view.

The present efforts of the maintenance departments is to exploit more fully the possibilities of this method, profiting by the experience acquired during its application, which has already lasted some years, and the improved methods of investigating the actual condition of the permanent way. The necessity for maintenance operations is no longer based on a simple estimation of the actual condition of the track, but chiefly to estimate the probable rate at which it will wear.

(<sup>1</sup>) We would remind readers that this report only covers normal maintenance properly so called, and that the summaries would be very different from large scale renewals for which purpose mechanisation is highly developed on a good many railways.

There will be a considerable saving due to the reduced mileage to be dealt with, a better definition of the elementary work, and a reduction in the number of intermediate overhauls.

Recording vehicles give invaluable services from this point of view as regards the factors to which they are sensitive. By a comparison of successive recordings, they make it possible to follow the evolution of the condition of a given line.

The application of such methods, which reduces to the minimum the work to be done, must be completed by a very careful check of the quality of the elementary work and the results as a whole. Here again, recording vehicles are of great value.

III. — The organisation of the work encourages the separate carrying out of the elementary operations. This makes possible a better definition of the work to be done, better preparation of the equipment and materials required, and finally a choice of the most suitable season for carrying out the work. This method of working is particularly valuable in the case of mechanised gangs in order to assure the full employment of the equipment.

The succession in time of these elementary operations involves however a great deal of loosening and tightening up again of the same fastenings with undue fatigue as a result. This serious drawback can be avoided, whilst keeping the men on specialised jobs, by combining the different elementary operations into phases which include all those dealing with the same fastenings as far as the total strength of the gang makes possible.

Gangs of 15 to 20 platelayers seem to be the most suitable for overhauling the track in successive phases which will avoid any further work being done to a fastening once it has been tightened up.

Such gangs in addition require less protection that the very large gangs and the cost of protection is better distributed than in the case of small gangs.

The radius of action does not involve

moving the men around in special staff trains, as they are able to return home every day. They can be formed by grouping together 2 or 3 neighbouring gangs daily when inspection obligations or accommodation difficulties makes it necessary to have the staff living along the line.

The development of the technique of small engines has enabled manufacturers to perfect all kinds of machines for overhauling the material. Such machines are mostly used individually, but they usually require at least two men to take them off the line; working in gangs makes it easy to do this. Under certain conditions of visibility however this involves a greater degree of protection than in the case of manual gangs. The attention of manufacturers has been called, at the request of the Administrations, to the perfecting of operating controls preventing any mistake in the working harming the track equipment, even if the staff has not been specially trained.

From the point of view of the overhaul of the qualitative factors (level, keying, gauge) no Administration has reported the existence of any mechanical machines enabling such good results to be obtained, at least in the case of the classic type of permanent way, as shovel packing, and a high rate of productivity even on the most heavily loaded lines.

IV. — The extension of the sphere of action of the gangs raises the problem of their transport from their homes to their place of work with the minimum loss of time. Collective transport, in cases where there live close together, individual transport where their homes are scattered.

Transport by means of trolleys only covers requirements on lines with little traffic where the traffic regulations are very flexible.

To make other methods of transport effective, the men must be able to get close to their place of work.

In old countries, where the track is generally narrow, it is not possible to make pathways for road vehicles except at points

where the road and railway crosses. On the other hand, except in mountain regions, it is usually easy to make a cycle pathway alongside the ballast. Such pathways however do not allow the use of heavy and bulky maintenance equipment.

In countries with a scattered population where there is generally plenty of room alongside the track and where it is possible to run vehicles alongside the railway, the construction of pathways is not necessary to allow the men to get to their place of work.

V. — The two factors in the evolution of maintenance, concentration of the gangs and mechanisation, are capable of giving considerable economies compared with the present position. However, each of them has limits to its application.

Concentration enables the management to follow more closely the work of the gangs. It soon loses its advantages, however, owing to the high cost of travelling and lodging when the gang becomes too large and works over such a wide area that the men can no longer return home at night. The social advantages of this possibility are however extremely important.

Mechanisation gives a great increase in individual output, though the saving on the work as a whole is much less. It decreases very rapidly when the amount of work to be done is small and when the traffic on the lines in question is considerable (<sup>1</sup>). It requires very careful pre-determination of the work to be done to avoid useless operations.

The choice of the solution to be adopted depends on technical factors relating to the condition of the line, the amount of traffic and the character of the latter which determines the importance of the qualitative factors which are essentially generators of

(<sup>1</sup>) As we have already said these summaries relate entirely to current maintenance. They would be very different were it question of wide scale renewals which is a type of work involving a great many operations.

comfort in the case of the classic type of line.

The influence of economic demographical factors also plays a great part in the choice of a solution.

Whichever solution is adopted, its general application will only be crowned with success when a managerial staff is available so trained that it knows the possibilities and limitations of the new methods, as well as its role in the economies which must result from their application.

VI. — The replies received from the various Administrations all deal with organisation as applied to the maintenance of the classic type of permanent way.

Progress now being made in the techni-

que of permanent way laying (suppression of joints) and in the technique of the material (increasing the life of sleepers) will make it possible, if present hopes are fulfilled, to reduce to a considerable extent the amount of work to be done between two overhauls. The number of platelayers required for actual maintenance will therefore be considerably reduced, and new organisations may have to be studied for maintenance gangs.

The problem of supplementary burdens (inspection and obligations in connection with level crossings with keepers in particular) should be the subject of a special study, as in practice in the future it will be impossible to make the maintenance gangs responsible for this if their output is not to be considerably reduced.

## APPENDICES

## APPENDIX I.

## C. 1. — Kind of equipment.

Twenty-five Administrations replied to this appendix

The following table gives the number of Administrations regularly or experimentally using each tool.

Kind of tool	In regular use	Used experimentally	Remarks
1 - Machine to bush wooden sleepers . . . . .	3	4	
2 - Rollers to move track equipment sideways when putting into position . . . . .	3	»	
3 - 5 tonne jack lifting rails . . . . .	21	»	
4 - 10 tonne jack for lifting track equipment . . . . .	7	3	
5 - Truck running on one rail . . . . .	5	2	
6 - Device to move sleepers . . . . .	2	1	
7 - Device to bind the ends of sleepers to prevent them splitting . . . . .	12	1	
8 - Device to load the rails . . . . .	6	2	
9 - Device to bend rails and the blades of switches . . . . .	15	3	
10 - Equipment to move the rails longitudinally . . . . .	13	2	
11 - Hand saw for rails . . . . .	22	»	
12 - Mechanical saw for rails . . . . .	9	3	
13 - Hand drill for rails . . . . .	22	1	
14 - Mechanical drill for rails . . . . .	15	1	
15 - Hand drill for sleepers . . . . .	16	»	
16 - Mechanical drill for sleepers . . . . .	11	1	
17 - Self-emptying ballast wagon . . . . .	11	3	
18 - Weed-killing train . . . . .	13	2	
19 - Jib crane on rails . . . . .	4	1	
20 - Crane to lay track equipment . . . . .	»	»	
21 - Gantry crane . . . . .	1	»	
22 - Coachscrew driving machine . . . . .	14	2	
23 - Machine to tamp the track (type?) . . . . .	11	3	Scheuchzer, Matisa, Ingersoll -Rand.
24 - Pneumatic vibrators for consolidating the ballast . . . . .	1	7	Jakson, Barco, Kango.
25 - Large motor trolleys for the gangs . . . . .	9	4	
26 - Motor trolleys . . . . .	19	2	
27 - Machine to screen the ballast . . . . .	7	5	Matisa.
28 - Levelling machine to level the ballast . . . . .	1	2	
29 - Electric generator set . . . . .	15	3	
30 - Apparatus for laying sleepers . . . . .	1	2	
31 - Other apparatus and machines : Belt conveyor for loading the ballast . . . . .	»	1	
Rail cracks detector . . . . .	1	»	
Cutters . . . . .	7	»	
Notchers . . . . .	5	»	
Aluminothermic or electric welding groups	12	»	

## ANNUAL NUMBER OF HOURS PER KILOMETRE OF TRAFFIC

WORK CARRIED OUT BY THE MEN	Belgian Railways S.N.C.B.		Spanish Railways R.E.N.F.E.		
	Line with the heaviest traffic		Line with heavy traffic		Line with the least traffic
		%		%	%
Training the staff (schools) . . . . .	2.2	0.12	»	»	»
Supervision { Tours of inspection . . . . .	52.5	2.87	32.16	0.94	1.52
Replacing keepers . . . . .	13.	0.71	165.18	4.85	259.53
Night calls. . . . .	»	»	0.67	0.02	0.29
Maintenance of the main lines { Methodical maintenance { Levelling, shimming, lining up, consolidation or replacement of material (rails, sleepers, small equipment). Improving the ballast.	688	37.61	2 006.91	58.72	2 098.15
					77.5
Maintenance as found necessary { Levelling, shimming, lining up, consolidation or replacement of material (rails, sleepers, small equipment). Improving the ballast.	36	1.97	32.16	0.94	1.52
					0.0
Systematic tightening up of the fastenings	35	1.91	242.72	7.12	86.22
Maintenance of service lines . . . . .	606	33.12	303.40	8.90	124.68
Protection of the staff . . . . .	68	3.72	»	»	»
Transport and handling of materials . . . . .	8	0.44	133.41	3.91	8.49
Weeding, cleaning out ditches, repairing tools, driving the trolleys . . . . .	54	2.95	55.82	1.64	12.32
Landslides, clearing away snow . . . . .	35	1.91	1.99	0.06	»
Large scale repairs to the track . . . . .	8.8	0.48	27.06	0.79	»
Maintenance of buildings and roads . . . . .	105	5.74	327.67	9.62	52.94
Supervision of work done under contract . . . . .	13.5	0.74	10.27	0.30	0.98
Time allowed for extra distance . . . . .	»	»	»	»	»
Sickness . . . . .	68.5	3.74	67.85	1.99	58.87
Loss of time due to bad weather . . . . .	36	1.97	»	»	»
Totals . . . . .	1 829.5	100	3 407.27	100	2 705.51
					100

(2) These figures refer to years during which important electrification works were carried out. In normal year i.e. 2.84 %.

DEVOTED TO THE TASKS ENUMERATED BELOW. — Column 1.

French Railways S.N.C.F.				French C.F.E.		Régie Autonome des Transports Parisiens				Algerian Railways	
Line with the heaviest traffic		Line with the least traffic		Line with the least traffic		Line with the heaviest traffic Urban system		Line with heavy traffic Seaux Line		Line with average traffic	
	%		%		%	on the spot	%	on the spot	%		%
9.2	0.41	4.7	1.56	»	»	210	18.29	98	3.81	2	0.17
24	1.08	6.3	2.09	35	6.25	»	»	»	»	41	3.45
39.8	1.79	»	»			»	»	»	»		
687 (2)	30.96	70.5	23.34	200	35.72	486	42.34	690	26.82	602	50.73
				75	13.39	225	19.60	450	17.49	91	7.67
107	4.82	15.3	5.07			25	4.46	»	»	80	3.11
						70	6.10	81	3.15	11	0.93
166	7.48	10	3.33	25	4.46	5	0.43	73	2.84	57	4.80
96	4.32	0.75	0.25	»	»	44	3.83	108	4.20	5	0.42
154	6.94	21.5	7.12	35	6.25					27	2.27
113	5.10	45	14.90	105	18.76	13	1.13	40	1.55	102	8.59
2.7	0.12	»	»	2	0.36	»	»	34	1.32	31	2.61
267	12.03	61	20.20	»	»	11	0.96	114	4.43	24	2.02
35	1.58	0.93	0.31	15	2.68	»	»	600	23.32	18	1.52
293 (2)	13.20	0.93	0.31	4	0.71	24	2.09	60	2.33	5	0.42
5.7	0.26	34.5	11.43	»	»	»	»	»	»	8	0.67
124	5.59	26	8.60	24 (1)	4.28	60	5.23	145	5.63	120	10.11
96	4.32	4.5	1.49	15	2.68	»	»	»	»	43	3.62
2 219.4	100	301.91	100	560	100	1 148	100	2 573	100	1 187	100
				(1) wounds excluded							

ould be : Methodical maintenance 917 hours, i. e. 41.32 % ; Supervision of work done under contract 63 hours.

## ANNUAL NUMBER OF HOURS PER KILOMETRE OF TRA

WORK CARRIED OUT BY THE MEN	<i>Tunisian Railways</i>		<i>Cameroons Railways</i>	
	Line with small traffic	Line with small traffic	Line with small traffic	Line with small traffic
Training the staff (schools) . . . . .	"	"	"	"
Supervision { Tours of inspection . . . . .	40	3.85	180	5.04
Replacing keepers . . . . .	31	2.99		
Night calls . . . . .	"	"		
Maintenance of the main lines { Methodical maintenance { Levelling, shimming, lining up, consolidation or replacement of material (rails, sleepers, small equipment). Improving the ballast.	422	40.66	1 640	45.94
Maintenance as found necessary { Levelling, shimming, lining up, consolidation or replacement of material (rails, sleepers, small equipment). Improving the ballast.	32	3.08	120	3.36
Systematic tightening up of the fastenings	9	0.87	145	4.06
Maintenance of service lines . . . . .	48	4.62	230	6.44
Protection of the staff . . . . .	"	"	"	"
Transport and handling of materials . . . . .	42	4.05	15	0.42
Weeding, cleaning out ditches, repairing tools, driving the trolleys . . . . .	91	8.77	450	12.60
Landslides, clearing away snow . . . . .	138	13.29	6.4	0.18
Large scale repairs to the track . . . . .	68	6.55	208	5.83
Maintenance of buildings and roads . . . . .	32	3.08	166	4.65
Supervision of work done under contract . . . . .	24	2.31	"	"
Time allowed for extra distance . . . . .	no statistics		"	"
Sickness . . . . .	61	5.88	110	3.08
Loss of time due to bad weather . . . . .	"	"	300	8.40
Totals . . . . .	1 038	100	3 570.4	100

(continued)

VOTED TO THE TASKS ENUMERATED BELOW. — Column 1.

French West African Railways		Franco-Ethiopian Railway		Madagascar Railways		Moroccan Railways			
Line with small traffic		Line with small traffic		Line with small traffic		Line with heavy traffic		Line with small traffic	
»	%	variable	%	»	%	5	% 0.21	3	% 0.38
365	19.52	76	3.44	261 150	8.31 4.77	457 68	19.01 2.83	99 »	12.42 »
565	30.21	1 139	51.55	444	14.14	839	34.90	400	50.19
313	16.74	645	29.18	412	13.12	120	4.99	19	2.38
63	3.37	»	»	40	1.27	75	3.12	60	7.53
84	4.49	170	7.69	15	0.48	176	7.32	16	2.01
»	»	»	»	»	»	2	0.08	»	»
»	»	180	8.14	104	3.31	49	2.04	6	0.75
313	16.74	included in the maintenance		615	19.58	150	6.24	91	11.42
167	8.93	»	»	220	7.00	»	»	»	»
»	»	»	»	210	6.69	80	3.33	»	»
»	»	»	»	570	18.15	180	7.49	33	4.14
»	»	»	»	»	»	»	»	»	»
»	»	»	»	»	»	9	0.37	»	»
»	»	»	»	70	2.23	162	6.74	58	7.28
»	»	»	»	30	0.95	32	1.33	12	1.50
1 870	100	2 210	100	3 141	100	2 404	100	797	100

## ANNUAL NUMBER OF HOURS PER KILOMETRE OF TRA

WORK CARRIED OUT BY THE MEN	Mediterranean Niger Railway		Italian Railways		Luxemburg Railways	
	Line with small traffic	Line with heavy traffic	Line with heavy traffic	Line with average traffic	Line with average traffic	Line with average traffic
Training the staff (schools) . . . . .	»	»	»	»	10	0.7
Supervision { Tours of inspection . . . . .	240	22.33	306	8.92	195	15.00
Replacing keepers . . . . .	special rounds included					
Maintenance of the main lines	Methodical maintenance { Levelling, shimming, lining up, consolidation or replacement of material (rails, sleepers, small equipment). Improving the ballast.	610	56.75	1 970	57.45	275
	Maintenance as found necessary { Levelling, shimming, lining up, consolidation or replacement of material (rails, sleepers, small equipment). Improving the ballast.	96	8.93	359	10.48	400
	Systematic tightening up of the fastenings	4	0.37	»	»	included above
Maintenance of service lines . . . . .	10	0.93	120	3.50	223	17.19
Protection of the staff . . . . .	6	0.56	28	0.82	included in the supervision	
Transport and handling of materials . . . . .	20	1.86	8	0.23	43	3.3
Weeding, cleaning out ditches, repairing tools, driving the trolleys . . . . .	13	1.21	160	4.67	47	3.6
Landslides, clearing away snow . . . . .	22	2.05	12	0.35	32	2.4
Large scale repairs to the track . . . . .	11	1.02	128	3.73	»	»
Maintenance of buildings and roads . . . . .	15	1.39	»	»	30	2.3
Supervision of work done under contract . . . . .	»	»	154	4.49	»	»
Time allowed for extra distance . . . . .	»	»	56	1.63	»	»
Sickness . . . . .	18	1.67	80	2.33	45	3.4
Loss of time due to bad weather . . . . .	10	0.93	48	1.40	»	»
Totals . . . . .	1 075	100	3 429	100	1 300	100

(continued)

VOTED TO THE TASKS ENUMERATED BELOW. — Column 1.

Netherlands Railways		Portuguese Railways		Swiss Federal Railways		Rhaetian Railway		Syrian Railways	
Line with the heaviest traffic		Line with small traffic		Line with the heaviest traffic		Line with small traffic		Line with small traffic	
»	»	8	0.58	9	0.66	»	»	»	»
375	18.63	356	2.56 0.44	400	28.84	280	24.37	8189 38	0.56 13.25 2.66
420	20.87	355	25.96	170	12.54			84	5.89
605	30.06	334	24.41	410	30.24	383	33.33	506	35.45
80	3.97	187	13.67	»	»			36	2.52
unknown		100	7.31	included in the V. P. maintenance		»	»	104	7.29
»	»	33	2.41	38	2.80	»	»	»	»
93	4.62	36	2.63	30	2.21	»	»	36	2.52
230	11.43	130	9.50	12	0.88	21	1.83	145	10.16
»	»	36	2.63	90	6.64	250	21.76	36	2.52
46	2.28	»	»	7	0.52	71	6.18	91	6.38
23	1.14	»	»	35	2.58	»	»	149	10.45
25	1.24	»	»	9	0.66	3	0.26	»	»
»	»	»	»	17	1.25	30	2.61	»	»
93	4.62	108	7.90	138	10.18	111	9.66	5	0.35
23	1.14	»	»	»	»	»	»	»	»
2 013	100	1 368	100	1 365	100	1 149	100	1 427	100

**AVERAGE ANNUAL MAINTENANCE COSTS***The figures in italics show the average annual cost per kilometer of track.***I. — Average annual costs per km of track**

	<i>Belgian National Railways S.N.C.B.</i>	<i>OTRACO</i>	<i>Spanish Railways R.E.N.F.E.</i>	<i>Catalan Railways</i>
Daily output per km of track	(9 863)	(10 093)	(5 616)	(2 346)
a) Cost of track materials . . . . .	1 121 000 86.9	38 000 71.8	1 558 511 87.8	69 000 352
b) Railway Staff wages . . . . .	6 720 000 520.9	199 000 376.2	3 948 436 222.6	57 325 292.5
c) Contractors . . . . .	»		285 839 16.2	56 750 289.5
d) Total costs (a + b + c) . . . . .	7 841 000 607.8	237 000 448	5 792 786 326.6	183 075 934

**II. — Expenditure considered necessary to a**

a) Cost of track materials . . . . .		»	»	75 000 382
b) Railway Staff wages . . . . .	As above	»	»	77 500 395
c) Contractors . . . . .		»	»	50 000 255
d) Total costs (a + b + c) . . . . .		»	»	202 500 1 032

## CONVERTED INTO U.S.A. DOLLARS.

line according to table A<sub>2</sub> (in thousand Dollars).

Annual expenditure.

France S.N.C.F.	<i>Régie Autonome des Transports Parisiens</i>		Algerian Railways	Tunisian Railways	Cameroons Railways	West African Railways
	Urban Line	Sceaux Line				
(8 109)	(34 968)		(2 712)	(1 712)	(1 670)	(1 126)
22 067 000	157 142	51 477	628 000	142 856	53 269	96 852
267.6	338.6	735.4	122	81.4	94.4	23.2
45 081 000	156 174	43 971	3 370 000	1 273 603	329 296	1 791 762
546.6	336.6	628.1	654.7	726.1	583.9	428.9
4 748 000	214 043	56 174	»	7 264	»	»
57.6	461.3	802.5		4.2		
71 896 000	527 359	151 622	3 998 000	1 423 723	382 565	1 888 614
871.8	1 136.5	2 166	776.7	811.7	678.3	452.1

Oper maintenance of the whole of the System.

24 214 000		»	»	53 270	
293.6				94.4	
44 794 000	As above. However in a few years time the Sceaux line will have reached a satisfactory state of maintenance and it will be possible to reduce considerably the expenditure involved in heavy repairs and improving the ballast.	»	»	338 980	As above
543.2				601	
4 358 300		»	»	»	
52.8					
73 366 300		»	»	392 250	
889.6				695.4	

**AVERAGE ANNUAL MAINTENANCE COSTS***The figures in italics show the average annual cost per kilometer***I. — Average annual costs per km of track**

	<i>Franco-Ethiopian Railway</i>	<i>Madagascar Railways</i>	<i>Moroccan Railways</i>	<i>Mediterranean Niger Railways</i>	<i>Italian State Railways F.S.</i>
Daily output per km of track	(1 403)	(279)	(6 301)	(1 175)	(7 890)
a) Cost of track materials . . . . .	19 450 23.6	319 612 338.4	183 996 104.4	74 082 258.6	11 600 000 438.6
b) Railway Staff wages . . . . .	390 250 474.2	440 676 466.7	1 365 446 775.4	119 840 418.3	19 200 000 726
c) Contractors . . . . .	46 300 56.2	"	"	"	9 120 000 344.9
d) Total costs (a + b + c) . . . . .	456 000 554	760 288 805.1	1 549 440 879.8	193 922 676.9	39 920 000 1 509.5

**II. — Expenditure considered necessary to a**

a) Cost of track materials . . . . .		556 900 589.7	157 360 89.4	133 160 46.5	14 240 000 538.4
b) Railway Staff wages . . . . .	As above	460 050 487.1	1 229 870 698.3	119 840 41.8	22 100 000 835.7
c) Contractors . . . . .		"	"	"	12 000 000 453.7
d) Total costs (a + b + c) . . . . .		1 016 950 1 076.8	1 387 230 787.7	253 000 88.3	48 340 000 1 827.8

(continued).

apter A — § 4.

### INVERTED INTO U.S.A. DOLLARS.

line according to table A<sub>2</sub> (in thousand Dollars).

ual expenditure.

<i>Luxemburg Railways</i>	<i>Netherlands Railways</i>	<i>Portuguese Railways</i>	<i>Swiss Federal Railways C.F.E.</i>	<i>Rhaetian Railway</i>	<i>Syrian Railways</i>	<i>Greek Railways</i>
(7 144)	(11 370)	(2 465)	(11 644)	(1 889)	(420)	(2 795)
194 000	7 100 000	1 038 040	1 511 089	212 000	13 144	183 430
241.9	1 086.9	240.9	228.9	403	47.6	121
1 000 000	5 200 000	1 000 000	4 125 712	284 000	133 286	962 000
1 247.	796.1	232.1	625.1	539.9	484	632
"	1 300 000 199	"	"	"	9 143 33.2	"
1 194 000	13 600 000	2 038 040	5 636 801	496 000	155 573	1 145 430
1 488.9	2 082	473	854	942.9	564.8	753

per maintenance of the whole of the System.

	"	"		"	17 150 62	"
As above	"	"	As above	"	142 850 519	"
	"	"		"	14 300 52	"
	"	"			174 300 633	"

ADMINISTRATIONS	Please give a table of the sectional dimensions, weight per running metre and lengths of rails as now generally purchased by you.								Do you purchase Siemens-Martin steel rails? Thomas steel rails? Proportion as a percentage Strength in kg/mm <sup>2</sup> of the rails purchased by you
	Weight per metre	Height	Gauge of head	Width of rail base	Thickness of the web	Section in mm <sup>2</sup>	Length		
BELGIUM and COLONY : <i>S.N.C.B.</i> . . . . .	50	151	72	140	15	»	27 18	Thomas steel 70 to 80 kg. T breaking strength increased 2.5 times the elongation cent must be equal to a minim of 106.	
OTRACO . . . . .	33.4	134	58	105	11	»	12	Basic Bessemer steel : 70 kg.	
	40	130	62	120	13	»	15		
SPAIN : <i>R.E.N.F.E.</i> . . . . .	45	142	66	130	15	»	18 12	Bessemer steel : 49 % Siemens Martin steel : 51 % Thomas steel : very little ported, — between 70 and 85	
FRANCE, ALGERIA, TUNI- SIA, FRENCH UNION : <i>S.N.C.F.</i> . . . . .	46.3	145	62	134	15	»	24	Thomas steel : 100 % 70 kg minimum.	
	50.57	153	63	140	15.5	»	24 18		
R.A.T.P. . . . .	46	145	62	134	15	»	18	Thomas steel : 100 %	
	52	150	65	150	16	»	18	Standard rails : 65 to 70 kg Vignole rails : 75 to 80 kg	

TERIALS : RAILS AND SMALL FITTINGS.

	<p>Do you purchase any higher tensile rails for special purposes?</p> <p>In this case are these rails :</p> <ol style="list-style-type: none"> <li>1) made of a special alloy?</li> <li>2) welded rails with heads of harder steel?</li> <li>3) rails the heads of which have been hardened by special treatment of the surface?</li> <li>4) according to what process?</li> </ol>	<p>Do corrugations form on the surfaces of your rails to such an extent that they greatly increase the noise and loosen the rail fastenings?</p> <p>Do such corrugations occur chiefly on straight sections or on curves?</p> <p>Have you carried out trials to find out after what period or after the passage of how many gross tons weight the first corrugations occur in new rails?</p> <p>Have you taken any special steps to prevent the formation of such corrugations? What steps?</p> <p>Do you make use of special apparatus or machines to get rid of existing corrugations?</p> <p>What are these appliances or machines?</p>	<p>What special protective steps do you take in tunnels to prevent the formation of rust on the rails and other fastenings?</p>	<p>Do you bend the rails with special appliances before laying them on curves?</p>	<p>Do you use machines to straighten rails that are bent upwards and sideways? What are these machines?</p>
No	No.	Yes.	Copper bearing steel rails are used. This is not a general rule however.	No.	Yes, Simple presses: two supports or hooks with central screwed spindle. Not much used.
No		Yes, but of very limited extent and is not a serious problem. Consequently no steps have been taken to prevent or suppress it.	»	No.	Yes, bending machine.
Under trial = rails with the ends treated = 93 to 110 kg; martensitic : area 70 to 130 kg sorbitic with preliminary half annealing } 115 to 125 kg. sorbitic treatment Thomas steel : 80 kg minimum Tensile strength of sorbitic rails: 75 to 87 kg		Yes. It has not been possible to establish any general rule. Some undulations have appeared as soon as the line was laid. Others take years to appear. Making test to see if rubber sole plates and elastic fastenings can combat undulatory wear. Also testing limiting the carbon content. Are building a machine fitted with grinding shoes. Are testing HF heating equipment to soften the ridges.	India rubber is applied in certain tunnels	No.	Yes, press for straightening the rails.
Yes in the case of the curves on the Sceaux Line. Sorbitic treated rails.		Yes, particularly in curves and braking areas. No investigations nor any measures taken to obviate this. Trucks with abrasive shoes running at 35 km are used.	None.	Yes in the case of curves of less than 500 m radius.	Not up to the present.

Please give a table of the sectional dimensions, weight per running metre and lengths of rails as now generally purchased by you?

ADMINISTRATIONS	Weight per metre	Height	Gauge of head	Width of rail base	Thickness of the web	Section in mm <sup>2</sup>	Length	Do you purchase Siemens-Martin steel rails? Thomas steel rails? Proportion as a percentage? Strength in kg/mm <sup>2</sup> of the rails purchased by you	
<i>Algerian Railways . . . . .</i>	46	145	62	134	15		18	Preferably Thomas steel : 70 kg	
<i>Gafsa Railway . . . . .</i>	36	128	58	115	13		18	Thomas steel : 100 %	
<i>Tunisian Railways . . . . .</i>	36 46.3	128 145	58 62	115 134	13 15		18 18	Thomas steel : 100 % 65 kg	
<i>Cameroons Railways . . . . .</i>	30	125.5	56	106	11		12	Thomas steel : 100 % 65 kg	
<i>West African Railways . . . .</i>	30	125.5	56	106	11		12	Thomas steel : 100 % 65 kg	
<i>Franco-Ethiopian Railway . . .</i>	30	125.5	56	106	11		12	Thomas steel : 100 % 65 kg	
<i>Madagascar Railways . . . .</i>	30	125.5	56	106	11		12	Thomas steel : 100 % 65 kg	
<i>Moroccan Railways . . . . .</i>	46.3	145	62	134	15		18 18	Thomas steel : 100 % 65 kg	
<i>Mediterranean-Niger Rys. . . .</i>	55 kg in tunnels No rails purchased. The stock of rails of 35 to 39 kg from the old French stock is sufficient.							»	
<b>GREECE :</b> <i>Greek Railways . . . . .</i>	46.3	145	62	134	15		18	Thomas steel : 100 % 70 kg	

	<p>Do you purchase any higher tensile rails for special purposes?</p> <p>In this case are these rails :</p> <ol style="list-style-type: none"> <li>1) made of a special alloy?</li> <li>2) welded rails with heads of harder steel?</li> <li>3) rails the heads of which have been hardened by special treatment of the surface?</li> <li>4) according to what process?</li> </ol>	<p>Do corrugations form on the surfaces of your rails to such an extent that they greatly increase the noise and loosen the rail fastenings?</p> <p>Do such corrugations occur chiefly on straight sections or on curves?</p> <p>Have you carried out trials to find out after what period or after the passage of how many gross tons weight the first corrugations occur in new rails?</p> <p>Have you taken any special steps to prevent the formation of such corrugations? What steps?</p> <p>Do you make use of special apparatus or machines to get rid of existing corrugations?</p> <p>What are these appliances or machines?</p>	<p>What special protective steps do you take in tunnels to prevent the formation of rust on the rails and other fastenings?</p>	<p>Do you bend the rails with special appliances before laying them on curves?</p>	<p>Do you use machines to straighten rails that are bent upwards and sideways?</p> <p>What are these machines?</p>
No, except for LP rails heat treated for making crossings and switches.	Yes, especially on straight sections. No investigations, no steps to prevent them.	Bituminous paint or similar.	In principle no, except in the case of curves of less than 300 m radius.	Yes. Delachaux hook and motor bending machine with rollers.	
No.	Yes, on curves and on straight sections immaterially. Undulations occur after one year with 36 kg rails. No investigations nor steps to remedy this.	None.	No.	Yes, just installed in the shops.	
No.	Yes, beginnings undetermined; are not serious; no steps to prevent them.	None. Tarring in damp and salty situations	No.	No.	
No.	Yes, especially on straight sections. Have not occurred with standard 30 kg rails in use since 1947. No steps to prevent them.	None.	No.	Yes, press with rollers.	
No.	Yes, in no particular places. No measures to prevent them.	No tunnels.	No.	Yes, hand press.	
No.	Yes, especially in straight sections. No measures to prevent them.	None.	No.	No.	
No.	Yes, on the straight. No measures to prevent them.	Tarring.	Yes.	No.	
No.	Yes, are only small. No measure to prevent them.	None.	No.	No.	
»	»	No tunnels.	Exceptionally for rails in switches and small radius curves.	Yes, hand press.	
»	No.	No, except for old rails with a high percentage of carbon.	No.	No.	

Please give a table of the sectional dimensions, weight per running metre and lengths of rails as now generally purchased by you.

ADMINISTRATIONS	Weight per metre	Height	Gauge of head	Width of rail base	Thickness of the web	Section in mm <sup>2</sup>	Length	Do you purchase Siemens-Martin steel rails? Thomas steel rails? Proportion as a percentage? Strength in kg/mm <sup>2</sup> of the rails purchased by you
<i>Thessalian Railway . . . . .</i>								»
<b>ITALY :</b> <i>Italian State Rys. (F.S.) . . .</i>	49 60	148 171	66 72	125 145	14 16		36 48	In Italy : Siemens steel : 78 kg Imported : Thomas steel
<b>LUXEMBURG :</b> <i>Luxemburg Railways . . . . .</i>	46.3	145	62	134	15		36	Thomas steel : 100 % 70, 80 kg.
<b>NETHERLANDS :</b> <i>Netherlands Railways . . . . .</i>	46.9	142	74	120	14		15 18 24 30	Siemens-Martin steel : 18 % 70 kg minimum. Thomas steel : 82 % 70 kg minimum.
<b>PORUGAL and COLONIES:</b> <i>Portuguese Railways . . . . .</i>	45 50 55.7	144 153 155	60 63.6 62	134 140 134	15 15.5 19		18 18 18	Siemens-Martin steel : imported Thomas steel : 68 to 78 kg.
<b>SWITZERLAND :</b> <i>C.F.F. . . . . . . . . . .</i>	45.93	145	65	125	14		12.15 18.24 36	Siemens-Martin steel : 5 to 7 % 70 kg minimum. Thomas steel : 93 to 95 % 70 kg minimum.
<i>Rhaetian Railway . . . . .</i>	30.1	118	54	92	11		18	Siemens steel : 80 % 75 à 85 kg. Thomas steel : 20 % 75 à 85 kg.
<b>SYRIA :</b> <i>Syrian Railways . . . . .</i>				No rails purchased	since 30 years.			»

ERIALS : RAILS AND SMALL FITTINGS (continued).

	<p>Do corrugations form on the surfaces of your rails to such an extent that they greatly increase the noise and loosen the rail fastenings?</p> <p>Do such corrugations occur chiefly on straight sections or on curves?</p> <p>Have you carried out trials to find out after what period or after the passage of how many gross tons weight the first corrugations occur in new rails?</p> <p>Have you taken any special steps to prevent the formation of such corrugations? What steps?</p> <p>Do you make use of special apparatus or machines to get rid of existing corrugations?</p> <p>What are these appliances or machines?</p>	<p>What special protective steps do you take in tunnels to prevent the formation of rust on the rails and other fastenings?</p>	<p>Do you bend the rails with special appliances before laying them on curves?</p>	<p>Do you use machines to straighten rails that are bent upwards and sideways? What are these machines?</p>
»	<p>Yes, straight sections. No measures.</p> <p>Yes, after several years in service. No. measures to prevent them.</p>	<p>»</p> <p>None.</p>	<p>No.</p> <p>Yes. in the shops pressing or rolling machines.</p>	<p>»</p> <p>No.</p>
Yes, for use in curves of $R \leq 500$ m. Bimetallic rails. Head : 115 kg Tempered rails : 110 kg « Neuves Maisons et de la Providence » methods. Rail composition : C. 0.60, Mn. 1.40. Resistance constant throughout the section : 90 kg.	<p>No.</p> <p>Yes, in straight sections and curves. No measures to prevent them. Machines are being tried to remove them.</p>	<p>None.</p> <p>No tunnels.</p>	<p>No.</p> <p>No.</p>	<p>No.</p> <p>Yes, press and machine with rollers.</p>
Yes, hardened head, improved « Neuves Maisons » process.	<p>Yes in straight sections and curves. No information of any value.</p>	<p>None.</p>	<p>No.</p>	<p>No.</p>
Yes, special composition : C : 0.58; Si : 0.31; Mn : 1.45; P : 0.037; S : 0.028 min. Welded rails, the head being harder in the case of switches and on bridges. Rails with hardened head martensitic and sorbitic methods.	<p>Yes, on straight sections and curves, especially in braking areas. No special measures to prevent them. An enquiry is being held. Grinding trials are in hand.</p>	<p>Trials of steel with 0.2 to 0.3 % copper.</p>	<p>»</p>	<p>»</p>
Hard rails : C : 0.6; Mn : 1.5 = 90 kg. Rails with heads hardened by heat treatment : 120 kg surface strength of the head.	<p>Yes. In the first five years. A polishing wagon to get rid of them.</p>	<p>»</p>	<p>Yes.</p>	<p>»</p>
Head hardened by heat treatment.	<p>Occasionally in certain curves. No measures or remedies.</p>	<p>Lubrication.</p>	<p>Yes. Only for curves on steep gradient.</p>	<p>Yes, hand press.</p>

## APPENDIX IV A. — PERMANENT WAY MATERIALS

ADMINISTRATIONS	Do you get rid of uneven places on the running surface of the rail by building up by welding? What type of welding do you use?	Have you any equipment enabling you to treat the surface of the rails in any other way (planing machines, milling machines, grinding machines)?	Have you got any machines to remove the sharp edges of rails on the running side?	Do you short removed rail by sawing off damaged or bent ends
BELGIUM and COLONY :				
S.N.C.B. . . . .	Yes, for about a year. 1 <sup>o</sup> flame welding; 2 <sup>o</sup> grinding then electric welding.	No	Yes, in the central depot, whilst sorting the rails; on a planing-chamfering machine.	Yes for making new 35 m rails by electric welding
OTRACO . . . . .	No.	No	No	Yes
SPAIN :				
R.E.N.F.E. . . . .	No.	No	No	Yes in special cases
FRANCE, ALGERIA, TUNISIA, FRENCH UNION :				
S.N.C.F. . . . .	Yes, by electric welding or building up.	No	Yes, on the track with grinding trucks; in the shops with machines of the planer type.	Yes, 12 m rails are cut down to 11 m, 18 m or to 16.5 m.
R.A.T.P. . . . .	Yes, by electric arc welding.	No	No	Yes
Algerian Railways . . . . .	Yes, by electric or aluminothermic welding and building up the ends.	No	No	Yes, usually make longer rails

NAILS AND SMALL FITTINGS (*continued*),

Do you as a general rule remachine fastenings that have been taken down by pressing or welding? - bearing plates, - coachscrews, - other bolts and nuts, - wedges keys, - fishplates.	Is this repair work done in the railway shops or in privately owned factories?	What is the total average life in service you expect?		
		for your rails, i.e. what percentage of the total number of rails laid do you have to replace each year in order to avoid a loss of weight?	for the fastenings?	for the steel as a whole used in the permanent way?
sole plates : entirely by welding the edges; coach- screws : straightened out in a press; bolts : re- threaded. Fishplates : restamped 1 to 3 mm.	Entirely in the railway workshops.	"	"	"
Fishplates built up by welding.	Railway workshops.	30 years.	15 years	"
No.	No.	35 years.	25 years	30 years
Wedges, coachscrews by for- ging and rethreading; fish- plates by restamping.	Railway workshops	From 20 to 40 years on main lines. On secondary lines replace- ments are usually only made when hea- vier axle loads are introduced.	As in previous column but the cost of overhauling and restoring after the first period in service is usually too high to be of interest.	On the average 40 to 50 years.
No.	"	Urban lines : 35 years. Sceaux line : 25 years.	30 years	30 to 35 years
In principle no, unless it is to adapt small components to a new method of laying the rails.	Preferably by private firms.	S. G. : 30 to 40 years. N. G. : 50 to 60 years.	15 to 20 years	20 to 25 years
			Very variable according to the district and type of permanent way.	

## APPENDIX IV A. — PERMANENT WAY MATERIALS

ADMINISTRATIONS	Do you get rid of uneven places on the running surface of the rail by building up by welding? What type of welding do you use?	Have you any equipment enabling you to treat the surface of the rails in any other way (planing machines, milling machines, grinding machines)?	Have you got any machines to remove the sharp edges of rails on the running side?	Do you short removed rails by sawing off damaged or bent ends?
<i>Gafsa Railway . . . . .</i>	No.	No	No	Yes for reuse in other places
<i>Tunisian Railways . . . . .</i>	No. Building up the frogs of crossings.	No	No.	No.
<i>Cameroons Railways] . . . . .</i>	No.	No	No.	Yes
<i>West African Railways . . . . .</i>	»	»	»	Yes for stations.
<i>Franco-Ethiopian Railway . . .</i>	No.	No	No.	No
<i>Madagascar Railways . . . . .</i>	No.	No	»	Yes for stations.
<i>Moroccan Railways . . . . .</i>	No.	No	No.	No
<i>Mediterranean-Niger Rys. . .</i>	No. Building up the frogs of crossings.	Yes.	No.	Yes for stations.
<b>GREECE :</b>				
<i>Greek Railways . . . . .</i>	No.	No	Yes, portable milling machines.	No
<i>Thessalian Railway . . . . .</i>	»	»	»	»

S AND SMALL FITTINGS (*continued*).

		What is the total average life in service you expect?		
		for your rails, i.e. what percentage of the total number of rails laid do you have to replace each year in order to avoid a loss of weight?	for the fastenings?	for the steel as a whole used in the permanent way?
Do you as a general rule use machine fastenings that have been taken down by pressing or welding? bearing plates, coachscrews, other bolts and nuts, wedges keys, fishplates.	Is this repair work done in the railway shops or in privately owned factories?			
No.	»	Cannot reply. Rails manufactured in 1899 are still in stock.		30 years in the case of new lines with 30 kg rails
Restamping of the fishplates.	Railway shops.	80 years except on curves.	Coachscrews : 15 to 30 years. Sleeper clips : 30 to 50 years.	rails : 80 years; small components: 25 to 50 years.
No.	»	15 years, on curves $R = 120$ to 250. 40 years elsewhere.	40 years	15 years
No.	»	50 years.	20 years	50 years
Restamping of the fishplates.	Railway shops.	50 years.	»	»
No.	»	25 years.	20 years	24 years
"Metal sleepers are straightened by means of a press.	»	35 years.	Replacements necessitated by increasing the loads and to get rails for re-use.	
No, exceptional.	Railway shops.	No experience. In sandy areas loaded with chloride, the coachscrews and bolts rust very rapidly and have to be renewed every 8 years.		
No.	»	60 years.	30 years	50 years
No.	»	Abutment rails since 1886.		

## APPENDIX IV A. — PERMANENT WAY MATER

ADMINISTRATIONS	Do you get rid of uneven places on the running surface of the rail by building up by welding? What type of welding do you use?	Have you any equipment enabling you to treat the surface of the rails in any other way (planing machines, milling machines, grinding machines)?	Have you got any machines to remove the sharp edges of rails on the running side?	Do you shear removed rails by sawing off damaged or bent ends?
ITALY :				
<i>Italian State Rys. (F.S.) . . . . .</i>	Brake marks are got rid of by building up with electric welding.	No.	Yes, being installed in the Pontassieve shops.	Yes, 36 m tened to 34 (118 ft. to 11 and 12 m (3 to 11 m lengths. into 44, 34 and (144, 111, 10 lengths.
LUXEMBURG :				
<i>Luxemburg Railways . . . . .</i>	No, only welding of joints.	No.	No.	No.
NETHERLANDS :				
<i>Netherlands Railways . . . . .</i>	No.	No.	Yes. Whetstones.	Yes.
PORUGAL and COLONIES:				
<i>Portuguese Railways . . . . .</i>	No.	No.	No.	No.
SWITZERLAND :				
<i>C.F.F. . . . .</i>	Crushed ends are built up on the line by autogenous or electric welding.	"	"	"
<i>Rhaetian Railway . . . . .</i>	Yes. Electric welding.	Yes. Milling machine.	No.	No.
SYRIA :				
<i>Syrian Railways . . . . .</i>	No.	No.	No.	Yes.

S AND SMALL FITTINGS (*continued*).

Do you as a general rule machine fastenings that have been taken down by pressing or welding? bearing plates, coachscrews, other bolts and nuts, wedges keys, fishplates.	Is this repair work done in the railway shops or in privately owned factories?	What is the total average life in service you expect?		
		for your rails, i.e. what percentage of the total number of rails laid do you have to replace each year in order to avoid a loss of weight?	for the fastenings?	for the steel as a whole used in the permanent way?
Yes.	Private factories.	30 years.	15 years.	50 years.
Only the fishplates.	Private factories.	30 years.	30 years.	30 years.
Fishplates and coachscrews as an experiment.	Fishplates : railway shops. Coachscrews : private factories.	Average : 30 years.	40 years.	"
Yes.	Railway workshops.	"	"	"
"	"	22 years. when first used; then 30 years.	"	50 to 60 years.
"	"	24 years.	24 years.	45 years.
Only bolts.	Railway workshops.	50 years.	15 years.	40 years.

APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	What proportion as a percentage of new sleepers do you use : — wood. — metal. — concrete?  In the case of wood sleepers what is the proportion as a percentage of : — hardwood sleepers (beech, oak)? — softwood sleepers (resinous)?	Do you impregnate your wood sleepers ? What product do you use and what method do you employ?	Have you any railway-owned premises for carrying out such impregnation ? What proportion of the sleepers are impregnated in these premises compared with those done in privately owned establishments ?	Do you manufacture wood sleepers in sawmills belonging to the railway ?
BELGIUM and COLONY : S.N.C.B.	Hardwood sleepers (oak, beech) : 100 %. Concrete sleepers : 2 %, experimentally on RV (renewal of tracks) and light sleepers on VS (secondary lines). Metal sleepers : 1 500 000 on the line, are now too costly.	Creosote Ruping method	100 % in the railway workshops.	Only the special sleepers for metal bridges or special purpose (swing-bridges)
OTRACO . . . . .	Metal sleepers : 100 %.	"	"	"
SPAIN : R.E.N.F.E.	Hardwood sleepers : oak ..... 35.3 % beech ..... 17.6 %  Softwood sleepers (ash) : 47.1 %	Creosote Single Ruping: oak and pine.  Double Ruping: beech.	100 in private establishments.	Yes owing to the shortage of timber. A 41.8 % of requirements. The expenditure allocation cover 33 % of the requirements.
FRANCE, ALGERIA, TUNISIA, FRENCH UNION : S.N.C.F.	There are now on the line : wood sleepers ..... 93 % metal sleepers ..... 5.6 % concrete sleepers ... 1.4 %  Now being laid each year : wood sleepers ..... 92 % metal sleepers ..... 1 % concrete sleepers ... 7 %	Creosote Bethell or single Ruping for oak, double Ruping for beech.	Railway workshops : 60 Private establishments : 40 %.	During the occupation and after the war. Since given up.
R.A.T.P. . . . .	Hardwood sleepers : 100 %.	Only those laid in the open, creosote Bethell and single Ruping.	100 % private establishments.	No.

LAST, WELDING IN CONNECTION WITH THE PERMANENT WAY.

Do you <i>on site</i> (on the track) salvage any of the sleepers taken up (planing, bushing)? In what proportion?	Are used sleepers repaired in special workshops (shops for the recovery of sleepers)?	What percentage of sleepers:		Are wood sleepers laid on the track treated by painting them with waterproofing products and are cracks in the wood filled up with protective products?
		do you re-use on the line after their first service?	must be regenerated compared with the total number of sleepers taken up and found to be re-usable?	
On site, in the case of planing and redrilling; sleepers that have to be rechaired, are generally replaced by others of the same size that have been repaired in the shops.	Yes, some 25 000 a year.	About 50 %.	»	Creosote on the re-cut surfaces. No protective coating to seal up splits.
»	»	Up to 100 %.	»	»
No.	No.	»	»	No.
Sleepers are generally overhauled in special shops.	25 % of the sleepers taken up during renewals are re-usable on the main lines. 50 % are re-usable on service lines; 60 % of the sleepers dealt with during maintenance operations are re-usable on service lines.	65 %	Yes, a few thousand sleepers were treated experimentally; splits are not sealed up by a protective coating. Sleepers are hooped in the shops and on the line.	
Yes, from 5 to 20 %	No.	From 5 to 20 %.	100 %	Recut parts are tarred.

## APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	What proportion as a percentage of new sleepers do you use : — wood, — metal, — concrete ? In the case of wood sleepers what is the proportion as a percentage of : — hardwood sleepers (beech, oak)? — softwood sleepers (resinous)?	Do you impregnate your wood sleepers ? What product do you use and what method do you employ ?	Have you any railway-owned premises for carrying out such impregnation ? What proportion of the sleepers are impregnated in these premises compared with those done in privately owned establishments ?	Do you manufacture wood sleepers in sawmill belonging to the railway	
<i>Algerian Railways</i> . . . . .	Hardwood sleepers (oak, zeen and cedar) ..... 27% Metal sleepers ..... 33% Concrete sleepers ..... 40%	Creosote Bethell	100% railway workshops.	Yes, a few and special ones for switches.	
<i>Gafsa Railway</i> . . . . .	Metal sleepers : 100%, on the running line. Hardwood sleepers on switches and bridges : 100%.	Creosote or carbonyl.	100% private establishments.	No.	
<i>Tunisian Railways</i> . . . . .	At the present time 100% hardwood sleepers. They are being replaced by metal or concrete sleepers.	Sleepers imported from Europe are creosoted: sleepers manufactured locally are not impregnated.	No. Recovered sleepers are impregnated cold.	No.	
<i>Cameroons Railways</i> . . . . .	Metal sleepers ..... 100%	"	"	"	"
<i>West African Railways</i> . . . . .	Metal sleepers ..... 98.3% Concrete sleepers ..... 1.7%	"	"	"	"
<i>Franco-Ethiopian Railway</i> . . . . .	Metal sleepers ..... 100%	"	"	"	"
<i>Madagascar Railways</i> . . . . .	Hardwood sleepers ..... 10% Metal sleepers ..... 90%	No.	No.	Yes.	
<i>Moroccan Railways</i> . . . . .	Hardwood sleepers ..... 10% Metal sleepers ..... 90% Concrete sleepers : replacing wood sleepers on S.L.	Sleepers imported from France are impregnated by the S.N.C.F.	No.	No.	
<i>Mediterranean-Niger Rys.</i> . . . . .	Hardwood sleepers ..... 60% Softwood sleepers ..... 40% Metal sleepers to be used in the future.	d <sup>u</sup> Trials are now being carried out with impregnating native sleepers with coco-nut oil.	No.	No.	

LAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (continued).

Do you on site (on track) salvage any the sleepers taken (planing, bushing)? in what proportion?	Are used sleepers repaired in special workshops shops for the recovery of sleepers?	What percentage of sleepers :		Are wood sleepers laid on the track treated by painting them with waterproofing products and are cracks in the wood filled up with protective products?
		do you re-use on the line after their first service?	must be regenerated compared with the total number of sleepers taken up and found to be re-usable?	
Most often off the track : 30 %.	Yes, in certain cases with mobile units (machine for charring, drill) especially on secondary lines.	Very variable, about 50 %.	20 %	Splits are painted with coal-tar, pieces of wood on points are completely covered with coal tar.
No.	No.	None.	None.	No.
No.	Yes.	15 to 20 %	»	Parts that have been recut are brushed over.
»	»	»	»	»
»	»	»	»	»
»	»	»	»	»
Yes, 20 %.	No.	20 %	40 %	No.
No.	Yes.	10 %	10 %	No.
No.	Yes.	60 %	100 %	Yes.

APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	<p>What proportion as a percentage of new sleepers do you use :</p> <ul style="list-style-type: none"> <li>— wood,</li> <li>— metal,</li> <li>— concrete?</li> </ul> <p>In the case of wood sleepers what is the proportion as a percentage of :</p> <ul style="list-style-type: none"> <li>— hardwood sleepers (beech, oak)?</li> <li>— softwood sleepers (resinous)?</li> </ul>	<p>Do you impregnate your wood sleepers? What product do you use and what method do you employ?</p>	<p>Have you any railway-owned premises for carrying out such impregnation? What proportion of the sleepers are impregnated in these premises compared with those done in privately owned establishments?</p>	Do you manufacture wood sleepers in sawmills belonging to the railways?	
GREECE :					
<i>Greek Railways</i> . . . . .	Hardwood sleepers ..... 10% Metal sleepers ..... 90%	Yes, creosote or coaltar. Ruping single or double, Wolman (single or composite).	Yes.	No longer	
ITALY :					
<i>Italian State Rys. (F.S.)</i> . . . . .	Hardwood sleepers ... 97% Softwood sleepers .... 2.97% Metal sleepers ..... 0.03% Concrete sleepers on trial.	Yes, except oak sleepers without sapwood : 10%. Ruping single or double.	30 % Railway workshops. 70 % private establishments.	No.	
LUXEMBURG :					
<i>Luxemburg Railways</i> . . . . .	Hardwood sleepers ..... 100% Concrete sleepers on trial.	Yes, single or double Ruping or Bethell.	No.	No.	
NETHERLANDS :					
<i>Netherlands Railways</i> . . . . .	Hardwood sleepers ..... 58% Softwood sleepers ..... 38% Concrete sleepers ..... 4%	Yes, creosote. Single or double Ruping.	100 % railway workshops.	No.	
PORUGAL and COLONIES:					
<i>Portuguese Railways</i> . . . . .	Softwood sleepers ..... 100%	Creosote, Ruping.	100 % railway workshops.	No.	
SWITZERLAND :					
<i>C.F.E.</i> . . . . .	Hardwood sleepers ..... 30% Metal sleepers ..... 70% Concrete sleepers on trial.	Creosote, single or double Ruping.	100 % private establishments.	No.	
<i>Rhaetian Railway</i> . . . . .	Hardwood sleepers ..... 3.5% Softwood sleepers ..... 1.5% Metal sleepers ..... 95%	Yes.	100 % private establishments.	No.	
SYRIA :					
<i>Syrian Railways</i> . . . . .	Hardwood sleepers on bridges. Metal sleepers : 100%.	Yes with vegetable tar.	No.	No.	

LAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (continued).

Do you on site (on the track) salvage any of the sleepers taken up (planing, bushing)? In what proportion?	Are used sleepers repaired in special workshops (shops for the recovery of sleepers)?	What percentage of sleepers:		Are wood sleepers laid on the track treated by painting them with waterproofing products and are cracks in the wood filled up with protective products?
		do you re-use on the line after their first service?	must be regenerated compared with the total number of sleepers taken up and found to be re-usable?	
No.	No.	10 %	»	No.
»	»	»	»	»
Yes.	No.	»	No.	No.
Yes. 100 %	No.	50 %	80 %	No.
A few.	Yes, since 1952.	70 %	70 %	No.
Yes.	No.	»	»	No.
Yes.	No.	»	» . . .	No.
No.	No.	30 %	»	Yes.
On site in the case of sleepers on metal bridges.		»	»	»

## APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	Is the salvaging of wood sleepers carried out : - in railway owned shops? - in privately owned shops?	Do you repair metal sleepers by welding, by building them up and welding parts of sleepers together end to end?	How many reusable metal sleepers do you get from repairing 100 recovered sleepers?	Are metal sleepers repaired : — in railway own shops? — at privately own factories?
BELGIUM and COLONY : <i>S.N.C.B.</i> . . . . .	100 % Railway workshops	Plates that have broken apart are rewelded. Plates are inserted where missing.	No repairs.	"
<i>OTRACO</i> . . . . .	"	No.	Up to 100 %	Railway workshops
SPAIN : <i>R.E.N.F.E.</i> . . . . .	"	No metal sleepers.	"	"
FRANCE, ALGERIA, TUNISIA, FRENCH UNION :				
<i>S.N.C.F.</i> . . . . .	In both	Yes; electric welding of cracks radiating round the opening. Sleepers that have warped are straightened.	When taking up the lines 60 to 70 %. When repairing the lines 100 %.	Private factories.
<i>R.A.T.P.</i> . . . . .	Close to the place where they will be used	"	"	"
<i>Algerian Railways</i> . . . . .	Mobile groups and workshops.	Straightening. Occasionally a small amount of welding.	100 %	Railway workshop

BALLAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (*continued*).

				How many tons of new ballast do you buy every year on the average per kilometre of line, i.e. according to the length of the system as determined under A.2.?	Please insert in the following table the different types of ballast which you use and their proportion as a percentage.		
Redwood sleepers	softwood sleepers	metal sleepers	concrete sleepers		Kind of ballast	Rock	Screen size
years on lines	10 years	Unknown	Unknown	Ballast .... 26.3 t	Ballast ..... 70 % Ballast ..... 13 % Gravel ..... 17 %	Porphyry sandstone or limestone, slag.	{ 40/60 20/140
years on secondary lines	10 years	Unknown	Unknown	Gravel .... 5.4 t			
»	»	30 years	»	About .... 75 t	Ballast broken stone.	Quartzite and limestone.	40/60
years	18 years	»	»	About .... 120 t	Ballast broken stone.	Hard limestone, quartzite.	30/80
20 to years	12 to 15 years	40 years	30 to 50 years allowed for according to characteristics and traffic	Ballast : renewals .. 29 t maintenance 5.7 t fine gravel . 14.7 t	Ballast broken stone: 65 %  Ballast slag .. 35 % Fine gravel broken stone 80 % Fine gravel slag 20 %	Granite, porphyry, quartzite, gneiss, basalt, sandstone, diorite, ophite and limestone with a high quality coefficient.	20/60  — d° — 20/40 10/30 10/25
20 to 3 years	»	»	»	Ballast .... 25 t	River pebbles 80 % Broken stone. 20 %	Porphyry and quartzite.	40/80 40/80
5 years 0 years in the case of cedar	»	30 to 40 years	25 to 30 years	Ballast : 31.27 t. This amount tends to decrease with the generalisation of measured shovel packing.	Broken stone, Fine gravel	Limestone, granite, basalt, exceptionally river aggregate.	40/50 15/30

## APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	Do you repair metal sleepers recovered from old railroads? — How many metal sleepers are recovered from old railroads?	Do you repair metal sleepers by welding, by building them up and welding parts of sleepers together and then How many re- usable metal sleepers do you get from repairing 100 recovered sleepers?		Are metal sleepers repaired : — in railway own- ership? — at privately owned factories?
EGYPTIAN RAILWAYS	No.	By welding and building up.	20 %.	Railway workshops
Tunisian Railways	Railway workshops.	Straightening of warped sleepers. Making ties for secondary lines and pits.		Railway workshops
Cameroons Railways		Straightening; cracked sleepers are thrown out.	~5	Railway workshops
West African Railways		Straightening warped sleepers.	100 %.	Railway workshops
Franco-Ethiopian Railway	"	No.		"
Madagascar Railways	Railway workshops.	No.	None	None.
Moroccan Railways	Railway workshops.	Straightening by means of a press.	95 %	Railway workshops
Mediterranean-Niger Rys.	In the yards.	"	"	"
GREECE : Greek Railways	No.		"	"
Thessalian Railway	"	"	"	"

LAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (*continued*).

What total period of service do you expect on the average from :				How many tons of new ballast do you buy every year on the average per kilometre of line, i.e. according to the length of the system as determined under A.2.?	Please insert in the following table the different types of ballast which you use and their proportion as a percentage.		
wood pers	softwood sleepers	metal sleepers	concrete sleepers		Kind of ballast	Rock	Screen size
years	»	40 years	»	Ballast : 0.03 t.	Broken stone	Limestone.	70/80 old tracks 60 renewed tracks.
10 to years	5 to 7 years	60 to 80 years	»	Ballast : 22.5 t.	Broken stone.	Hard limestone.	30/50
years	»	40 years	»	None has been bought for many years.	Broken stone . 100%	Cenerite and gneiss.	40/72
»	»	50 years	No expe- rience	Ballast : 37 t.	Broken stone . 100%	Limestone and sandstone.	30/60
»	»	50 years	»	Very variable.	Broken stone . 100%	Basalt.	20/40
years	»	40 years	»	Ballast : 1.6 t.	Broken stone . 87% Sand ..... 13%	Granite.	50/70
5 to years	»	50 years	25 years	Ballast : 9.1 t.	Broken stone . 100%	Quartzite.	30/70
20 to years	10 to 12 years	»	15 to 25 years	None purchased; the spoil heaps of quarries are used for what is needed 15 t.	Broken stone . 5% Gravel un- screened .... 95%	Limestone.	60/100 10/20
0 years	12 years	60 years	»	Ballast : 15 t.	Pebbles from torrents. Broken stone.	Limestone.	8/50 30/70
to 10 y.				Ballast : 13 t.	Broken stone.	Limestone.	»

## APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	Is the salvaging of wood sleepers carried out : — in railway owned shops? — in privately owned shops?	Do you repair metal sleepers by welding, by building them up and welding parts of sleepers together end to end?	How many reusable metal sleepers do you get from repairing 100 recovered sleepers?	Are metal sleepers repaired : — in railway owned shops? — at privately owned factories?
ITALY : <i>Italian State Rys. (F.S.) . . .</i>	Are not overhauled.	Welding the chairs.	80 %	Private factories
LUXEMBURG : <i>Luxemburg Railways . . . . .</i>	On site.	No.	None.	None.
NETHERLANDS : <i>Netherlands Railways . . . . .</i>	Railway workshops.	"	"	"
PORUGAL and COLONIES: <i>Portuguese Railways . . . . .</i>	"	"	"	"
SWITZERLAND : <i>C.F.F. . . . .</i>	"	Are repaired by electric arc welding; flashbutt spark welding under consideration.	88 "	Private factories
<i>Rhaetian Railway . . . . .</i>	"	No.	"	"
SYRIA : <i>Syrian Railways . . . . .</i>	"	Under consideration	"	"

BALLAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (*continued*).

What total period of service do you expect on the average from :				How many tons of new ballast do you buy every year on the average per kilometre of line, i.e. according to the length of the system as determined under A.2.?	Please insert in the following table the different types of ballast which you use and their proportion as a percentage		
Hardwood sleepers	softwood sleepers	metal sleepers	concrete sleepers		Kind of ballast	Rock	Screen size
2 years	14 years	50 years	»	Ballast : 90 t.	Broken stone... 90% Gravel ..... 1% Fine gravel ... 9%	Limestone, lava, basalt. Serpentine ..... Porphyry, arena-ceous granite.	30/60 30/60 15/25
0 years	20 years	25 years	»	Ballast : 32 t.	Ballast ..... 65% Shot ..... 35%	Broken slag.	40/60 5/15 and 10/25
25 years	25 years	»	»	Ballast : 30 t.	River pebbles . 80% Broken pebbles 11% Fine gravel ... 9%	»	10/55 and 30/65 12/23 12/32
»	14 years	»	»	Purchases much reduced.	»	Limestone.	»
30 years	»	60 years	»	Ballast : 55 t. Will be reduced to 40 or 45 t.	Broken stone. Fine gravel	Sandstone, gneiss. Porphyry, limestone siliceous limestone.	40/60 and 20/40 15/30
20 years	10 years	50 years	»	»	Rolled pebbles 100%	Limestone.	30/70
10 years	6 years	50 years	»	Ballast : 45.5 t.	Broken stone.	Basalt limestone.	»

APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPER

ADMINISTRATIONS	Do you obtain longer rails by end to end welding : — of new rails? — of salvaged rails?	Do you use aluminothermic welding for welding your rails?	
		Have you special gangs of welders?	Do you employ contractors?
BELGIUM and COLONY : <i>S.N.C.B.</i> . . . . .	New rails : $27 \times 2$ m . . . . . 54 m Salvaged rails . . . . . 35 m Long rails for tunnels and metal bridges.	Yes. Not permanently.	Yes.
<i>OTRACO</i> . . . . .	Yes.	Yes.	No.
SPAIN : <i>R.E.N.F.E.</i> . . . . .	Yes : $12 \times 2 = 24$ m (78.7 ft) during renewals.	A gang is going to be trained.	Yes.
FRANCE, ALGERIA, TUNISIA, FRENCH UNION : <i>S.N.C.F.</i> . . . . .	Yes, by welding new or old 18 or 24 m (19.6 to 26.2 yards) rails end to end in order to make long rails up to 800 m (875 yards); 12 m rails are cut down to 11 m (12 yards) and welded into 22 m (24 yards) lengths.	Yes.	Yes.
<i>R.A.T.P.</i> . . . . .	Yes; new rails, in special cases (bridges on ballast).	No.	Yes.
<i>Algerian Railways</i> . . . . .	Yes.	No.	Yes.
<i>Gafsa Railway</i> . . . . .	Yes.	Yes.	No.
<i>Tunisian Railways</i> . . . . .	Yes, only in the case of salvaged rails.	Yes.	No.
<i>Cameroons Railways</i> . . . . .	Yes, only in the case of salvaged rails.	Yes.	No.
<i>West African Railways</i> . . . . .	Yes.	Yes.	No.

LAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (*continued*).

Have you used electric butt welding?		What other welding methods do you use for welding rails end to end (for example : gas welding, Sécheron welding)?	In what cases do you use these various types of welding?	Up to what lengths do you weld rails as a general rule in the shops or on the site?
Have you your own equipment or butt welding rails electrically?	Do you have such welding done in privately owned factories?			
Yes, welding machines	No.	Sécheron method now being introduced.	No set rules.	In the workshops : 54 and 35 m. On the site : 40 on M.L., and 108 on S.L. 45 m, 90 m, 300 m,
None.	»	»	»	
No.	No.	None.	No rules.	24 m and 36 m Long rails in tunnels.
Yes, in the Railway workshops.	No.	None.	Aluminothermic welding in the shops and on the line; electric welding only in the shops.	Vary according to the types laid : 22, 36, 72 and 144 m (24, 39, 79 and 157 yards) in the case of rails intended to be made up into long lengths.
No.	No.	None.	Welding not used as a general rule.	Welding not used as a general rule.
Yes, 1 mobile welding set.	No.	Some trials of torch welding; results as good and more economical than electric welding.	»	36 m and 72 m long rails in tunnels.
No.	No.	None.	»	36 m ( $2 \times 18$ or $3 \times 12$ ) 40 m ( $4 \times 10$ )
No.	No.	None.	»	20 m ( $2 \times 10$ ) and 24 m ( $12 \times 2$ ) 40 m ( $2 \times 20$ ) and 48 m ( $2 \times 24$ ) 72 m in 1 100 m long rails.
No.	No.	None.	Station sidings and to connect rails of different sections.	30 m rails of 20 kg and 27 kg 36 m rails of 26 kg and 30 kg standard.
Welding by electrodes in the Railway workshops.	No.	None.	Aluminothermic welding on the open line and electric welding by electrodes in the shops.	16 m ( $8 \times 2$ ). Trial 91 m (9.14 old rails $\times 10$ ) Two 1 000 m long rails.

## APPENDIX IV B. — PERMANENT WAY MATERIAL : SLEEPERS

ADMINISTRATIONS	Do you obtain longer rails by end to end welding : of new rails? of salvaged rails?	Do you use aluminothermic welding for welding your rails?	
		Have you special gangs of welders?	Do you employ contractors?
<i>Franco-Ethiopian Railway . . .</i>	Yes, new rails.	Yes.	No.
<i>Madagascar Railways . . . . .</i>	»	»	»
<i>Moroccan Railways . . . . .</i>	No.	Trials are going to start during 1955 in tunnels, by the undertaking.	
<i>Mediterranean-Niger Rys. . . .</i>	»	»	»
GREECE : <i>Greek Railways . . . . .</i>	Yes, salvaged rails.	Yes.	No.
<i>Thessalian Railway . . . . .</i>	»	»	»
ITALY : <i>Italian State Rys. (F.S.) . . .</i>	Yes.	Yes, in the case of unimportant or difficult work.	
LUXEMBURG : <i>Luxemburg Railways . . . . .</i>	Yes, salvaged rails.	No.	No.
NETHERLANDS : <i>Netherlands Railways . . . . .</i>	Yes.	Yes.	No.
PORTUGAL and COLONIES: <i>Portuguese Railways . . . . .</i>	Yes, new rails.	No.	No.
SWITZERLAND : <i>C.F.F. . . . . . . . . . .</i>	Yes.	No.	Yes.
<i>Rhaetian Railway . . . . .</i>	Yes.	No.	Yes.
SYRIA : <i>Syrian Railways . . . . .</i>	»	»	»

LAST, WELDING IN CONNECTION WITH THE PERMANENT WAY (*continued*).

Have you used electric butt welding?		What other welding methods do you use for welding rails end to end (for example : gas welding, Sécheron welding)	In what cases do you use these various types of welding?	Up to what lengths do you weld rails as a general rule in the shops or on the site?
Have you your own equipment or butt welding rails electrically?	Do you have such welding done in privately owned factories?			
No.	No.	None.	»	»
»	»	»	»	»
No.	No.	»	»	»
»	»	»	»	»
No.	No.	None.	»	12 m by welding short salvaged rails together.
»	»	»	»	»
Yes.	No.	None.	Aluminothermic welding in the stations close to the site; electric welding in the shops.	48 m (4 × 12); 36 m (12 × 3 and 18 × 2); 44 m (11 × 4); 33 m (11 × 3).
No.	No.	Gas and electric welding.	For building up the points of switches and rail joints.	27 m on the site.
Yes.	No.	None.	Aluminothermic welding in the shops and on the line; electric welding in the shops.	30 m to 36 m in general. Long rails on bridges.
Yes.	»	»	»	36 m
Yes.	Yes.	Sécheron method.	Aluminothermic and Sécheron welding on the line; electric welding in the shops.	36 m
No.	No.	Sécheron method.	»	24 m and 30 m
»	»	»	»	»

	<i>Belgian National Railways</i> S.N.C.B.	<i>Otraco</i>	<i>Spanish Railways</i> R.E.N.F.E.	<i>Catalan Railways</i>	<i>French National Railways</i> S.N.C.F.
<i>Nota. — For the definition of the classification of lines refer to Part V, A, § 1.</i>					
<i>Maximum speeds authorised and actually run, differentiating between steam traction, electric traction and railcars.</i>					
Very important lines . . . . .	120 km and 140 km				120 km, 130 140 km Electric traction.
Important lines . . . . .	100 km to 110 km		Steam : 105 km railcar: 110 km Talgo train : 110 km		120 km
Average lines . . . . .	90 km	60 km	TAF train : 120 km These speeds are actually limited to 100 km	70 km	120 km - 100
Lines of little importance . . . . .	70 km		70 km	50 km	80-50 km
<i>Average number of men per kilometre of main line . . . . . (M. = men)</i>					
Very important lines . . . . .	0 M. 54				0 M. 63
Important lines . . . . .	0 M. 46		1 M. 04		0 M. 53
Average lines. . . . .	0 M. 40				0 M. 44
Lines of little importance . . . . .	0 M. 32	1 M. 4	0 M. 96		0 M. 16
<i>Average size of the maintenance gangs and average length of the principal section (including switches) maintained by them. (M. = men)</i>					
Very important lines . . . . .	6 to 18 M. : 20 km		DV = 14 M. ; 16 km		8 to 10 M. - 1
Important lines . . . . .	Minimum : 6 M. for shovel packing		VU = 9 M. : 8 km		7 to 8 M. ; 1
Average lines. . . . .		9 M. : 5 km	8 M. : 10 km		6 to 8 M. ; 2
Lines of little importance . . . . .				9 to 10 M. : 10 to 11 km	5 to 6 M. ; 3
<i>Average hourly rate of pay of a platelayer (in U.S.A. dollars)</i>	0.50	0.046		0.114 (*)	0.378 (*)
<i>Average hourly cost of the same platelayer including all costs (in U.S.A. dollars) . . . . .</i>	0.86	0.103		0.158	0.750
(*) Family allowance being deducted . . . . .					

<i>France</i> C.F.E.	FRANCE <i>Régie Autonome des Transports Parisiens</i>	<i>Algerian Railways</i>	<i>Gafsa Railway</i>	<i>Tunisian Railways</i>	<i>Cameroons Railways</i>	<i>West African Railways</i>
0 km - 70 km		Steam .... 95 km   Railcar ... 110 km	{ Steam ... 55 km { Railcar .. 90 km			
		Steam ... 120 km   Railcar .. 120 km	{ Steam ... 55 km { Railcar .. 80 km	Diesel railcar	SG km 90 100	NG km 70 100
0 M. 24		0 M. 79	0 M. 94			
		0 M. 44	0 M. 53	0 M. 45	0 M. 90	0 M. 94
7 to 9 M.; 3 to 35 km		8 M. to 20 M.	Division 20 to 25 km Section 3 to 9 km	5 to 6 M. - 7 to 8 km	27 M. 68 km	8 to 11 M.; 10 km
0.31						
		0.45			Permanent staff : 0.31 (*) Temporary : 0.18 (*)	0.137
0.49		0.93			Permanent staff : 0.53 Temporary : 0.23	0.154
						0.20

	Franco-Ethiopian Railway	Madagascar Railways	Moroccan Railways	Mediterranean Niger Railways	Viet Nam Railways	Greek Railways
<i>Nota.</i> — For the definition of the classification of lines refer to Part V, A, § 1.						
<i>Maximum speeds authorised and actually run, differentiating between steam traction, electric traction and railcars.</i>						
Very important lines . . . . .			Autho- rised : 115 km	In prac- tice : 105 km		
Important lines . . . . .			115 km	105 km		
Average lines. . . . .	Steam : 30 to 55 km	Steam : 45 km	90 km	85 km	Autho- rised km	In practice km
Lines of little importance . . .	Railcar : 70 km	Railcar : 80 km			steam 50	45
					railcar 80	75
<i>Average number of men per kilometre of main line . . . (M. = men)</i>					90 km	At present from 30 to 45 km
Very important lines . . . . .					st. 90	
Important lines . . . . .				0 M. 90	st. 90	
Average lines. . . . .				0 M. 80		0 M. 8
Lines of little importance . . .	0 M. 93	0 M. 84		0 M. 40	0 M. 62	1 M. 09
<i>Average size of the maintenance gangs and average length of the principal sections (including switches) maintained by them. (M. = men)</i>						
Very important lines . . . . .						
Important lines . . . . .				8 to 9 M.- 10 to 12 km		
Average lines. . . . .				8 M. - 11 km		8 to 9 [9.2 to 10]
Lines of little importance . . .	9 to 14 M. 12 km to 14 km	6 M. 10.4 km 26 M. 42.4 km		6 to 13 M.-12 to 54 km	26 M. 41.4 km	30 M.; 30 km [8 to 9 [9.2 to 10]
<i>Average hourly rate of pay of a platelayer (in U.S.A. dollars)</i>	0.087	0.061 (*)		0.50 (*)		0.156 (*)
<i>Average hourly cost of the same platelayer including all costs (in U.S.A. dollars). . .</i>	0.13	0.152		0.77		0.46
(*) Family allowance being deducted . . . . .						0.212

(continued).

APPENDIX

## CLASSIFICATION

## I. RESUME OF THE

ADMINISTRATION	of the type of track in terms of :				De
	the kind of trains	their speed	their number (tonnage)	max. axle loads	
BELGIUM :					
<i>S.N.C.B.</i> . . . . .					
SPAIN :					
<i>R.E.N.F.E.</i> . . . . .	»	»	»	»	»
<i>Catalan Railways</i> . . . . .	×	»	»	»	»
FRANCE, ALGERIA, TUNISIA AND FRENCH UNION :					
<i>S.N.C.F.</i> . . . . .					
<i>C.F.E.</i> . . . . .					
<i>R.A.T.P.</i> . . . . .					in terms of the traffic
<i>Algerian Railways</i> . . . . .	×	»	×	»	»
<i>Gafsa Railway</i> . . . . .					
<i>Tunisian Railways</i> . . . . .					
<i>Cameroons Railways</i> . . . . .	»	»	»	»	»
<i>West African Railways</i> . . . . .	»	»	»	»	»
<i>Franco-Ethiopian Railway</i> . . . . .	»	»	»	»	x (predominant)

## THE LINES.

## LINES RECEIVED

the number of men required for maintenance in terms of :				Classification based on other considerations or observations
the kind of trains	their speed	their number (tonnage)	max. axle loads	
»	»	»	»	3 groups according to the type of rail.
×	»	»	»	×
×	»	»	»	No classification properly speaking, the different groups having different characteristics are the subject of special studies.
the number of men depends on the amount of inspection and small maintenance jobs (all the jobs for which contractors are not called in).				Experimental regulations which take into account the traffic, the speeds and the loads allowed over a given section. 36 kg rails on 1333 sleepers are replacing the 25 kg rails on 1 200 sleepers.
in terms of the type of track and tolerances allowed for maintenance.				3 categories from the point of view of the tolerances : — lines run over by railcars at 90 km/h with a large amount of heavy traffic; — lines run over by railcars at between 60 and 90 km/h without much heavy traffic; — lines run over by railcars at 60 km/h without railcars and branch lines; Type of track determined by the Central Office of French Overseas Railways providing for rails of 30 kg.
Number fixed at 1 man per km owing to the amount of clearing up to be done which represents 25 % of the time.				
in terms of the traffic, varying from 1 man per km to 0.7 according to the importance of the traffic and type of permanent way.				
1 man per km for actual maintenance, but may be 3 men in the case of sections on particularly unstable ground.				

Administration	of the type of track in terms of :			
	the kind of trains	their speed	their number (tonnage)	max. axle loads
<i>Madagascar Railways</i> . . . . .				
<i>C.F.M.</i> . . . . .				
<i>Mediterranean-Niger Railways</i> . . . . .				
	Re-used material to be renewed with 46 kg rails on metal sleepers.			
<i>Viet-Nam Railways</i> . . . . .				
GREECE :				
<i>Greek Railways</i> . . . . .	In terms of the type of track and the strength of the line			
<i>Thessalian Railway</i> . . . . .	»	»	»	»
ITALY :				
<i>F.S.</i> . . . . .				
LUXEMBURG :				
<i>Luxemburg Railways</i> . . . . .				
NETHERLANDS :				
<i>Netherlands Railways</i> . . . . .	×	×	×	×
PORUGAL :				
<i>Portuguese Railways</i> . . . . .				
SWITZERLAND :				
<i>C.F.F.</i> . . . . .				
<i>Rhaetian Railway</i> . . . . .				
	Classified according to the layout of the line and the type of current (A.C., single phase or D.C.)			
SYRIA :				
<i>Syrian Railways</i> . . . . .				

REPLIES RECEIVED (*continued*)

the number of men required for maintenance in terms of				Classification based on other considerations or observations
the kind of trains	their speed	their number (tonnage)	max. axle loads	
»	»	×	×	The classification also takes into account the layout and profile of the line together with the climate. The number of men varies from : 0.6 to 0.33 per km on main lines and from 0.2 to 0.10 on secondary lines. No classification, operating conditions being the same on all lines.
—	—	—	—	This classification is not systematically applied.
In terms of the amount of material to be replaced which has reached the limit of wear and the general condition of the line.				
— 2 categories : the main artery and the branch lines.				
»	»	»	»	
—	—	—	—	
—	—	—	—	
The number depends on the category of the line and the size of the sections.				
»	»	»	»	»
—	—	—	—	
With the exception of the large gangs the number of men is the same throughout and is varied according to requirements by the addition of casual labour.				
—	—	—	—	
The number of men is based on experience without any systematic calculation.				
»	»	»	»	
—	—	—	—	
The number of men depends on the traffic increased if necessary by a few units on certain sections.				
—	—	—	—	

## II. DETAILED INFORMATION SUPPLIED BY CERTAIN ADMINISTRATIONS.

## FRANCE (S.N.C.F.).

Two classifications are made use of

according to the nature of the trains and the amount of traffic which define the number of men and upon which the general maintenance programmes are based:  
in terms of the kind of permanent way which dictates the conditions under which steam locomotives run.

The first classifies the lines into 4 categories

Category of line	Daily tonnage	Number of men per kilometre of single track line
<i>Category 1.</i> — Lines with very heavy traffic of fast trains and important kilometric tonnage.		
Has 2 sub-categories 1 A — lines run over by a large number of express trains . . . . .	31 250 t	0.70
1 B — . . . . .	20 830 t	0.60
<i>Category 2.</i> — Lines with a fairly large kilometric tonnage and run over by a certain number of fast and express trains . . . . .	16 670 t	0.50
<i>Category 3.</i> — Lines with an average kilometric tonnage which can be run only by a few express trains and by stopping trains . . . . .		
Has 2 sub-categories 3 A — lines run over by express trains. . . . .	13 890 t	VU = 0.48 DV = 0.40
3 B — lines run over by stopping trains or lines not open for passenger traffic but with an important freight traffic . . . . .	13 890 t	VU = 0.35 DV = 0.30
<i>Category 4.</i> — Lines with only small traffic . . . . .		
Has 2 sub-categories 4 A — lines run over by a few railcars or stopping passenger trains as well as goods traffic. . . . .		0.24
4 B — lines without passenger traffic and only small goods traffic. . . . .		0.16

The second classifies the lines into 5 groups according to the type of permanent way (modulus of inertia of the rail and sleeper spacing). The steam engines and tenders are also classified into 5 groups according to the weight of the heaviest axle

and factor of aggressiveness defined by the formula : 
$$\frac{K \cdot PL^2 V^2}{1\ 000 \cdot E}$$

The number of the group to which an engine belongs is the highest of that deriving from columns 4 and 5. An engine can run at the speed V used in calculating the factor of aggressiveness on all lines whose category number is equal to or higher than its own.

Type of track	Value of $\frac{I}{n} / l$	No of the groups of lines and engines	Engines	
			Weight of the heaviest axle	maximum value of $K \frac{PL2V^2}{1000E}$
1	2	3	4	5
very light . . . . .	100 to 140	1	17 tonnes	3 500
light . . . . .	141 to 179	2	18 »	5 500
average . . . . .	180 to 235	3	20 »	9 300
strong . . . . .	236 to 350	4	21.6 »	15 500
very strong . . . . .	more than 350	5	23 »	19 000

$\frac{I}{n}$  = modulus of inertia of the rail when half worn, in  $\text{mm}^3$ .

$K$  Coefficient  $\left\{ \begin{array}{l} 0.5 \text{ to } 0.6 \text{ with bogie} \\ 0.7 \text{ to } 0.8 \text{ with bissel} \\ 1 \text{ without bogie or bissel.} \end{array} \right.$

$l$  = distance between centres of two sleepers, in metres.

P = total weight of the engine.  
L = length excluding buffers.  
V = maximum speed.  
E = overall wheelbase.

#### MOROCCAN RAILWAYS (C.F.M.).

The lines are divided into two categories to determine the kind of permanent way and number of men required.

	Type of track	Number of men per kilometre of line
Lines with high speed passenger or heavy goods traffic . . . . .	46 k rails on 1611 to 1500 sleepers per km	0.60
Other lines . . . . .	36 k rails on 1500 to 1300 sleepers per km	0.33

#### SWISS FEDERAL RAILWAYS (C.F.F.).

Lines classified into four categories.

	Type of track	Number of men
Main lines of the 1 <sup>st</sup> category (lines run over at high speeds in the case of the through trains with a daily traffic of at least 10 000 T).	new material	The number of men is not calculated as a function of coefficients but as the result of experience, being sufficient for maintenance, inspection and other duties
Main lines of the 2 <sup>nd</sup> category. secondary lines of the 1 <sup>st</sup> category. secondary lines of the 2 <sup>nd</sup> category.	Worn material according to the condition of such material.	

## APPENDIX VII. RECORDING EQUIPMENT.

### *1. Special coaches.*

Two types of special coaches are used for recording the position of the rails

- 1) The Mauzin coach with 8 pairs of

wheels (fig. 1) which gives 7 full scale records (fig. 2) independently of the speed of running of the coach which can record even when attached to the fastest trains.

This coach is used by the S.N.C.F., the Belgian and Luxemburg Rys.

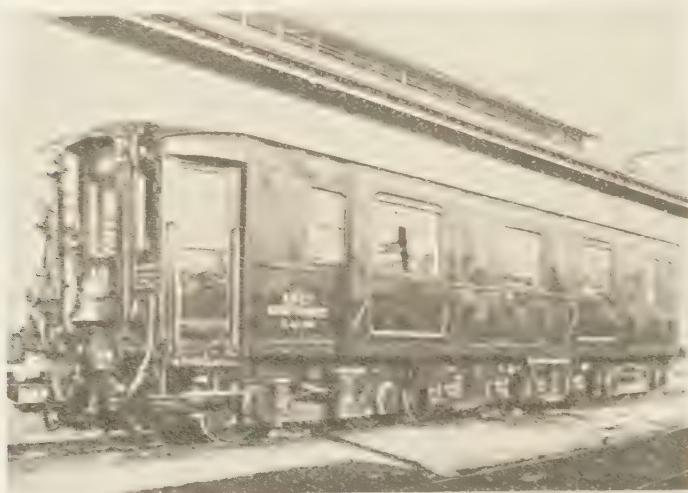


Fig. 1  
a) Mauzin coach. — General view.



b) Mauzin coach. — Interior view.

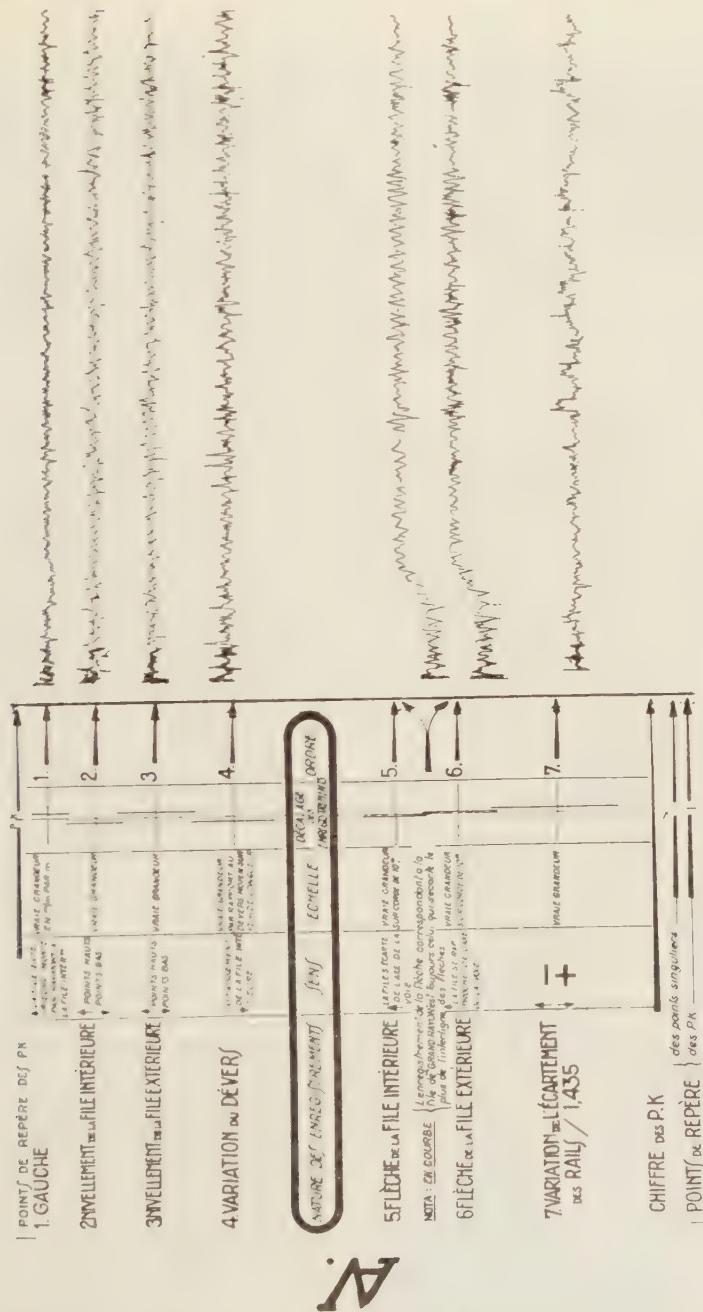


Fig. 2. - Mauzin record (scale : 1:2).

The photographs shown in fig. 3 show how the records are to be interpreted in the different cases in the case of defects sufficiently marked to be visible under direct observation.

Note - On a indiqué sur les ensembles suivants le nom de ces pièces ou éléments pour éviter toute confusion dans l'interprétation des figures.

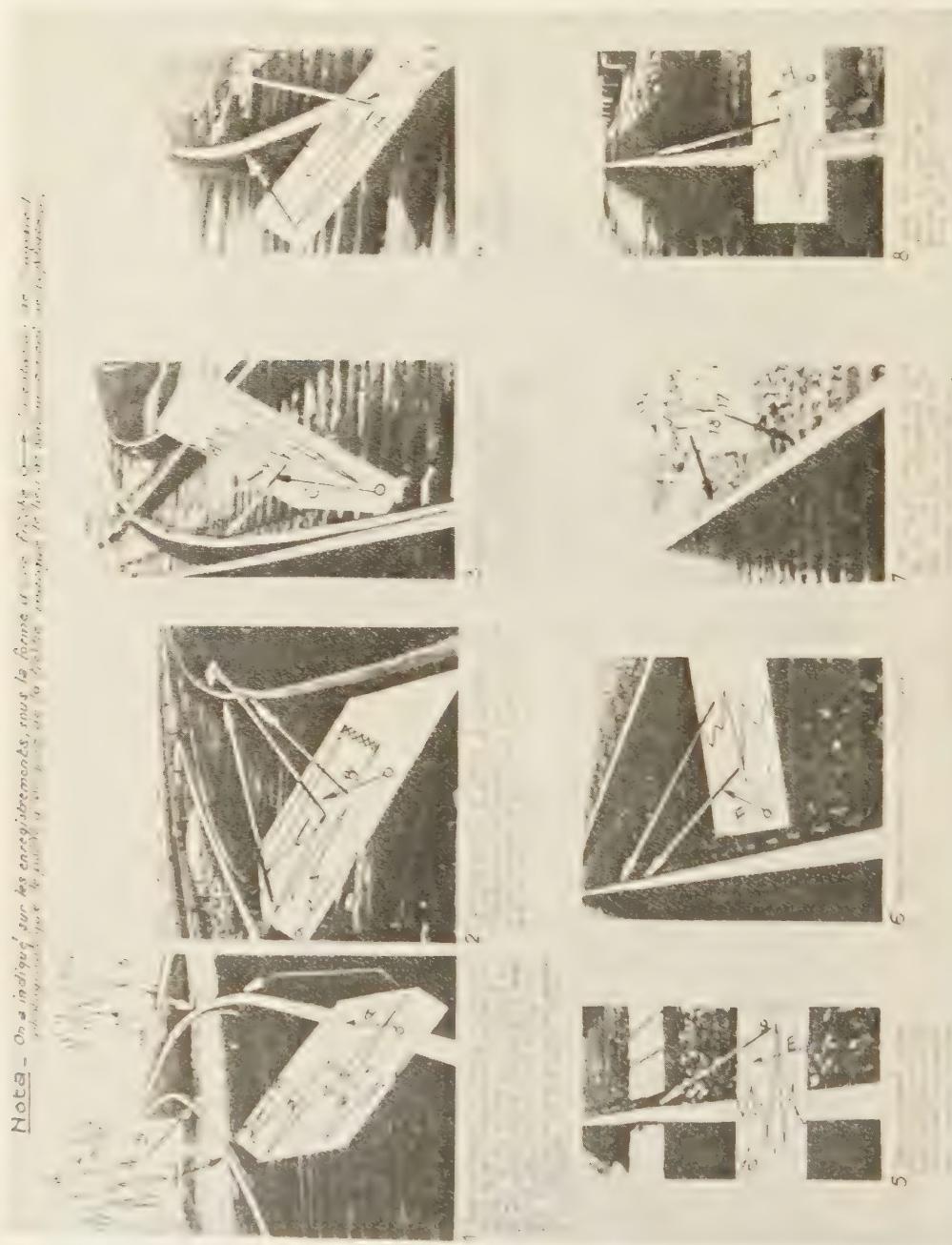


FIG. 3.

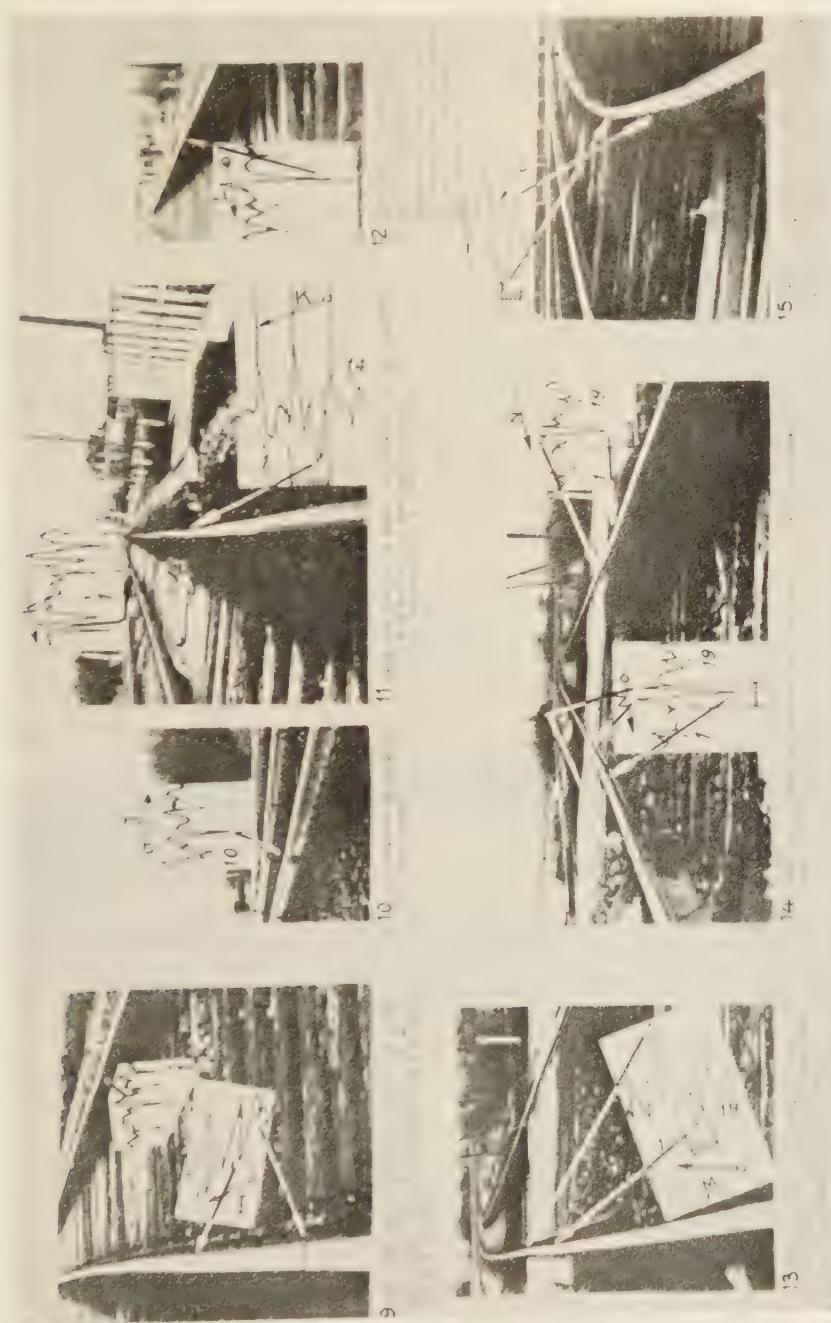


Fig. 3 (continued).

2) The Amsler coach, the diagram of which is given in fig. 4 and a recording on a reduced scale in fig. 5.

The records must be made at a speed of 60 km (37 miles)/h maximum.

This coach is used by the Swiss Federal Railways.

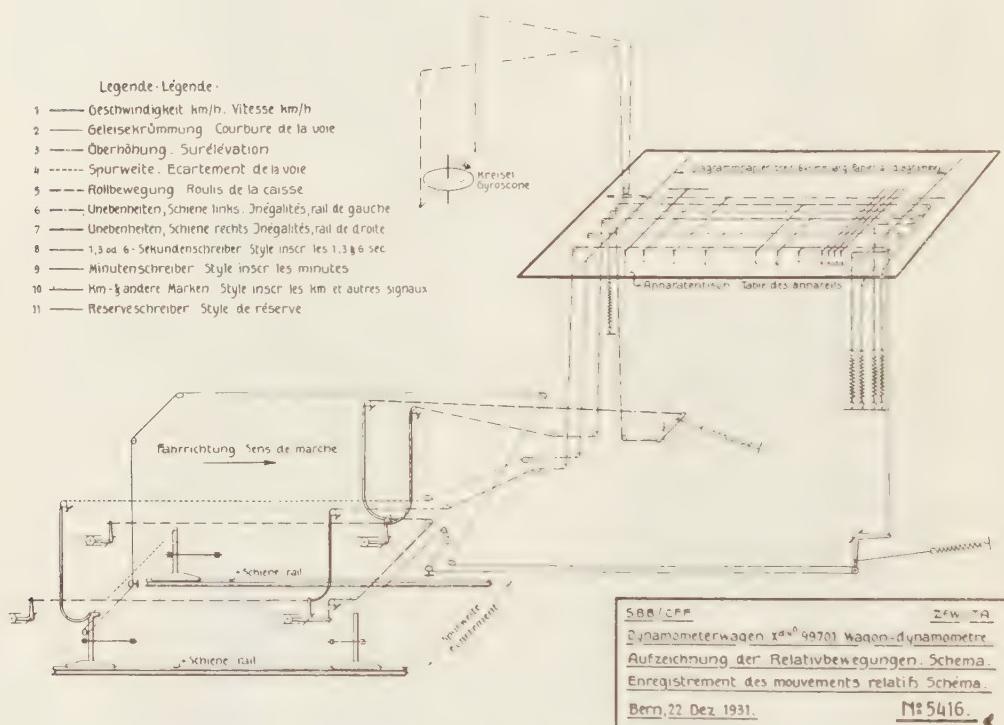


Fig. 4. — Amsler coach. — Diagram.

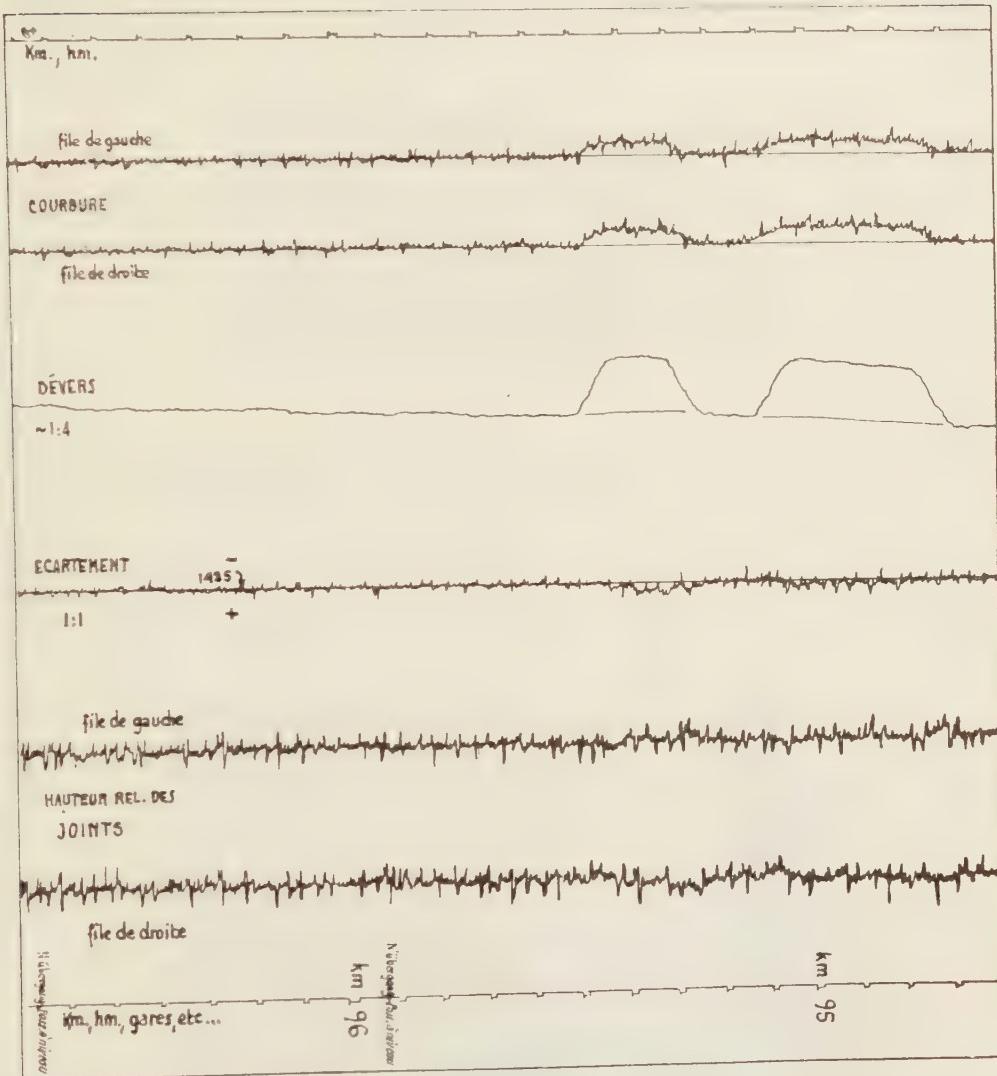


Fig. 5. — Amisler record (reduction 1/3).

## II. Hallade equipment.

The Hallade equipment records the reactions of the coach : variations in acceleration and rolling, effects of the cant and centrifugal force combined, vertical blows and oscillations (fig. 6).

This apparatus may be installed either in ordinary coaches, or better in railway service coaches, which allows, by comparing several successive recordings, the elimination to a certain extent of the factors relating to the suspension of the coach.

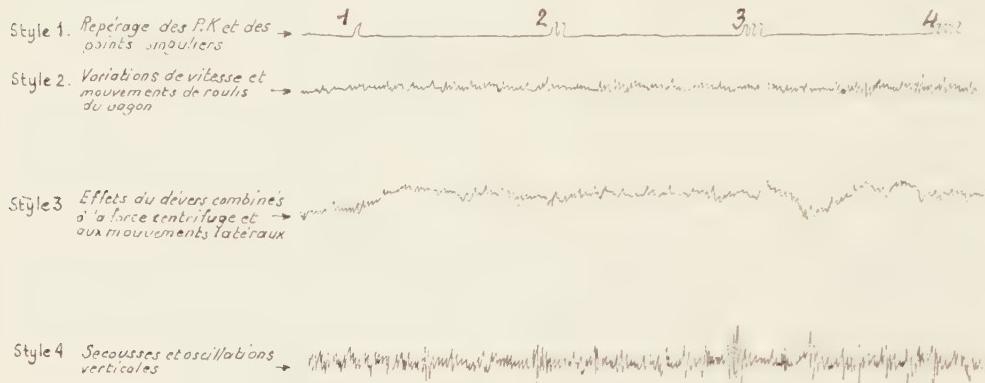


Fig. 6. — Hallade record.

The Hallade equipment is used by the S.N.C.F., Algerian, Cameroons, West African, Franco-Ethiopian, Madagascar, Moroccan and Italian Railways.



Fig. 7. — HEZZI machine. — General view.

### III. Light machines.

Three Administrations sent us details of the machines used by them.

The Italian Rys. use the IEZZI (fig. 7 and 8) and POLLAK machines which show directly irregularities and variations in the gauge and record them (fig. 9).

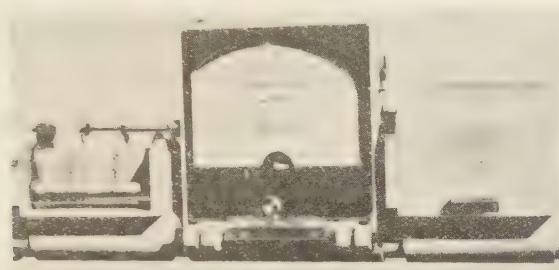


Fig. 8 — IEZZI machine. — Detail.

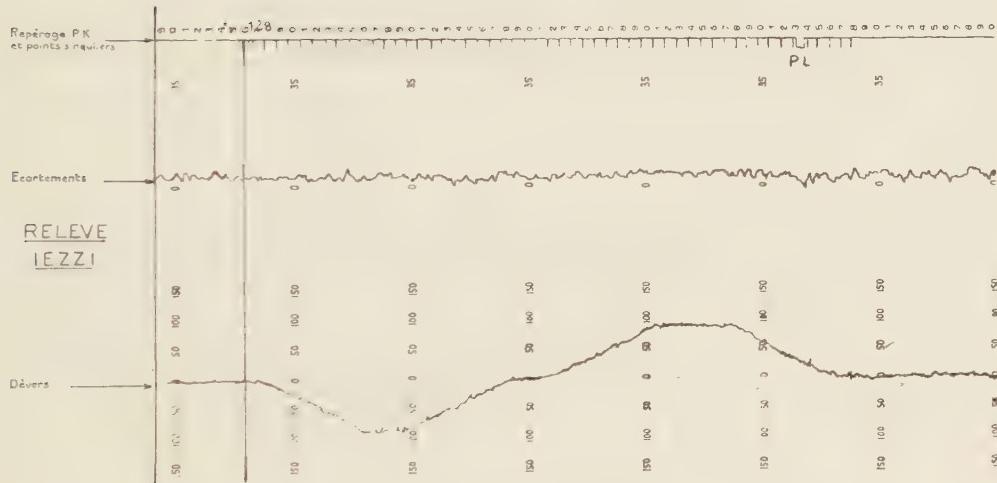
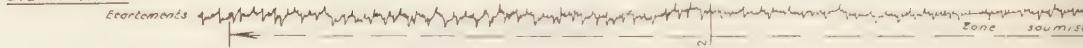


Fig. 9. — IEZZI record.

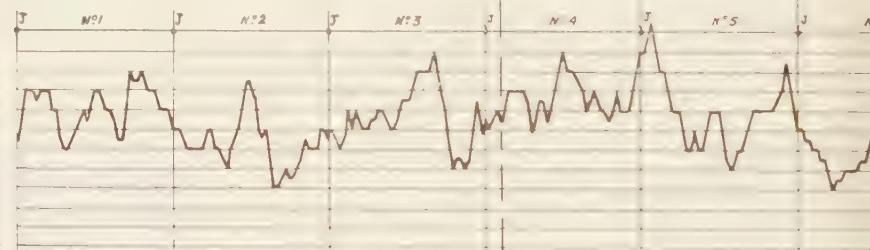
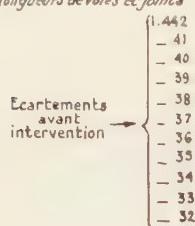
The West African Rys. state that they will use as from 1953 a MATISA trolley which will give a direct reading and a recording of the level, gauge and curvature.

The S.N.C.F. report the designing of a light machine which is hauled by a trolley and records full scale, together with a direct reading any irregularities, superelevation, longitudinal levels and the gauge.

Annexe VIII

Enregistrement Mauzin avant révision1 - Détermination par l'enregistrement de la zone à

- Réplacement de traverses →
- Chevillage →
- Retaille d'épaulements →
- Utilisation du jeu dans les selles →

2 - Détermination après prospection sur place delongueurs de voies et jointsEcartementsEnregistrement Mauzin après révision

38

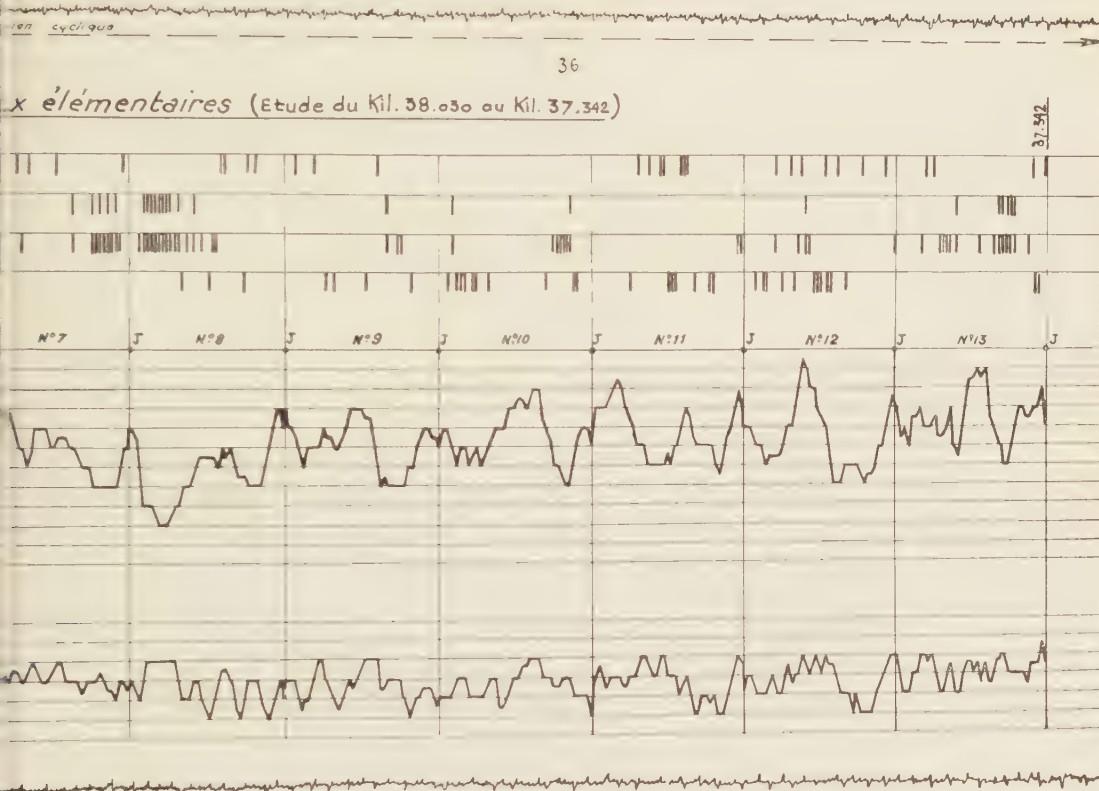
3 - Contrôle après exécution.

37

Explique

Annexe VIII = appendix VIII. — Enregistrement Mauzin avant révision = Mauzin record before spacings = 1 - determination of the section over which the gauge has to be corrected by needs correcting. — 2 - Détermination après prospection sur place des travaux élémentaires (kil. 38.030 to kil. 37.342). — Remplacement de traverses = replacement of sleepers. — Chevillage = utilisation de jeu in sole plates. — Longueurs de voies et joints = length of tracks and after overhaul. — Enregistrement Mauzin après révision = Mauzin record after the overhaul.

*ire l'objet d'une révision des écartements.*



36

*rich terms:*

overhaul. — 1 - Détermination par l'enregistrement de la zone devant faire l'objet d'une révision des écartements = gauge. — Partie devant subir une correction des écartements = section where the gauge determination = gauge. — 2 - détermination of the elementary work on site by inspection (study from 38.030 au kil. 37.342) = 2 - determination of the elementary work on site by inspection (study from 38.030 au kil. 37.342) = recutting bearing surfaces. — Utilisation du jeu dans les selles gaging. — Retaille d'épaulements = recutting bearing surfaces. — Utilisation du jeu dans les selles gaging. — Ecartements avant intervention = gauge before overhaul. — Ecartements après intervention = gauge control after execution = checking the way the work has been done.



# ANALYTICAL TABLE OF ARTICLES

## ARRANGED ACCORDING TO THE DECIMAL CLASSIFICATION

### (1953)

#### **3. SOCIOLOGY IN GENERAL.**

#### **31. STATISTICS.**

##### **313 .656. Railway transport statistics.**

Schweizerische Verkehrsstatistik, 1951 (*Swiss transport statistics, 1951*) (*New Book*) August 531

#### **38. COMMERCE. COMMUNICATIONS.**

##### **385. RAILWAYS FROM A GENERAL, ECONOMIC AND FINANCIAL POINT OF VIEW.**

Facts and Figures about British Railways (*New Publication*) March 182

##### **385 (02. Railway handbooks, treatises, etc.**

Directory of Railway Officials and Year Book, 1953-1954 (*New Book*) November 934

##### **385 (05. Periodicals.**

Archiv für Eisenbahntechnik (*Railway technical archives*) (*New Book*) February 126

##### **385 (06. Societies, associations, scientific congresses.**

##### **385 (06 .111. International Railway Congress Association. Official documents.**

OFFICIAL INFORMATION ISSUED BY THE PERMANENT COMMISSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION : List of questions for discussion at the XVIth Session (London, 1954), with the names of the Reporters . . . . . January 53

OFFICIAL INFORMATION ISSUED BY THE PERMANENT COMMISSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION. Meeting held by the Permanent Commission in Brussels, on the 17th January 1953, Appendix : List of Members of the Permanent Commission (17th January 1953) . . . . April 237

##### **385 (08. Annual reports of railway companies and administrations.**

Malayan Railway Administration Report for the year 1951, by J.O. SANDERS. (*New Publication*) . . . . . March 181

Red Nacional de los Ferrocarriles Españoles. — Memoria del Consejo de Administración. Ejercicio 1951 (*Spanish National Railways. — Report of the Administrative Council for the year 1951*) (*New Publication*) . . . . . August 182

##### **385 (09. History, description of railways, etc.**

Chemins de fer 1952 (*The Railways 1952*). A special supplement published by « Science et Vie » (*New Publication*) . . . . . January 61

Was weisst Du von den Bundesbahnen? / What do you know about the Federal Railways, by Dr. F. KARNER. (*New Publication*) . . . . . » 64

Central Railway Centenary Celebrations in Bombay, 16th April, 1953 . . . . . July 414

Indian Railways, 1853-1953, by F.C. BADHWAR. . . . . » 417

World Railways 1952-1953. (*New Book*) . . . . . August 530

**385 (09. 2. Obituary notices.**

	Month.	Pages
Rafael BENJUMEA BURIN . . . . .	March	179
Auguste MARGUERAT . . . . .	June	370
Gustaf DAHLBECK . . . . .	October	827

**385 .1. Railways from a financial point of view.****385 .11. Cost of construction and revenue derived.****385 .113. Result of working. Expenditure. Gross and net earnings. Ratio of expenditure to earnings.**

The administration of the Cameroun Railways, Review by the Management. — Year 1951  
(*New Publication*) . . . . .

January

60

Activité et productivité de la S.N.C.F. en 1952 (*The activities and productivity of the S.N.C.F. in 1952*) (*New Publication*) . . . . .

September

655

**385 .3. State control over railways.**

History and methods of Government regulation of Railway safety in Great Britain, by  
Brig. C.A. LANGLEY . . . . .

April

185

**385 .4. Internal administrative organisation of railways.**

Determination of the principles of geographical and functional organisation of a railway system. Simplification and retrenchment of the administration of railways. (Question 8, 16th Congress.)

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by Bengt ADAMSON . . . . .

September

573

Supplement to Report, by Bengt ADAMSON . . . . .  
Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia) by R. DUGAS . . . . .

October

729

December

949

**385 .5. Staff.****385 .57. Recruiting and promotion of staff and workmen.**

The Central Staff Records Office of the S.N.C.F., by R. PARÈS and A. RENAULT . . . . .

March

137

Modernisation of the methods to be adopted for recruiting the staff in number and qualification. Harmonious renewal of the various ranks, indispensable reserve lists, ratio of the permanent and temporary staff. Part played by the medical service in the recruiting. (Question 7, 16th Congress.)

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by F. LEMASS . . . . .

November

837

Supplement to Report, by F. LEMASS . . . . .

December

985

## 5. NATURAL SCIENCES.

### 55. GEOLOGY.

Convegno sulla Difesa del Suolo e le Sistemazioni fluviali e montane (*Congress of Soil Conservation and the Management of water courses and mountains*) . . . . .

March 183

## 62. ENGINEERING.

### 621. MECHANICAL AND ELECTRICAL ENGINEERING.

#### 621 .1. Steam engineering.

#### 621 .13. Locomotive engines.

##### 621 .13. (02 General treatises.

La locomotive à vapeur (*The steam locomotive*), by André CHAPELON (*New Book*) .

January 62

Henschel-Lokomotiv Taschenbuch (*Henschel pocket locomotive book*) (*New Book*) .

September 656

Cours d'Exploitation des Chemins de fer. Tome IV : Traction à vapeur, Traction électrique,

Traction Diesel, Freinage (*Railway Operating Course. Volume IV : Steam Traction, Electric Traction, Diesel Traction, Brakes*). — Second edition, by U. LAMALLE (*New Book*) .

October 829

#### 621 .135. Vehicle.

##### 621 .135 .4 Lateral play on curves. Bogies. Bissell bogies.

Wear of rails on curves : a) running effects of locomotives and motor coaches with motor bogies, b) characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails, c) results of the investigations made and proposed remedies. Use of rail-lubrication processes. (Question 10, 16th Congress.) :

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by V. VENKATARAMAYYA

September 533

Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia), by L. RIPERT . . . . .

October 737

#### 621 .3. Electrical engineering.

##### 621 .33. Electric railways and tramways. Railway electrification.

Technical and economic investigation of the basic characteristics of electric traction systems now in use, with a view to decide whether, and to what extent, there are relevant reasons for preferring one system to another. In particular are there any reasons in regard to : a) power supply, b) overhead line and fixed track installations, c) motive power units, d) working and maintenance costs. (Question 3, 16th Congress.) :

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by S.B. WARDER . . . . .

» 657

Protection of overhead lines, substations, locomotives and motor-coaches against accidents of electric nature (excess voltage, overloads, short-circuits, lightning). (Question 11, 16th Congress.) :

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by T.S. PICK . . . . .

November 887

	Month.	Pages.
<b>621 .337. Driving components.</b>		
Individual axle drive. Mechanical systems used on electric locomotives and motor coaches, with an indication of the results obtained in service on railways of all kinds ( <i>to be continued</i> ), by Adolphe-M. HUG	February May	65 245
<b>621 .392. Welding.</b>		
A new railway bridge constructed in welded steel, by M. FREI	April	227
<b>621 .4. Air, gas and oil engines.</b>		
<b>621 .43. Ignited-gas engines. Internal combustion engines.</b>		
<b>621 .431. General.</b>		
<b>621 .431 .7. Various applications.</b>		
<b>621 .431 .72. Railway traction.</b>		
Dieselisation of the West Clare Railway, by J.J. JOHNSTON	August	519
<b>621 .438. Gas turbines.</b>		
What the Union Pacific gas turbines have been doing	May	296
<b>621 .9. Machine tools.</b>		
Use of carbide tools for turning of wagon wheel sets, by J. OLSON	. . .	277
<b>624. BRIDGES AND ROOFS.</b>		
A new type of bridge superstructure	March	167
A new railway bridge constructed in welded steel, by M. FREI	April	227
<b>624 .3. Trussed bridges.</b>		
<b>624 .32. Metallic bridges.</b>		
The new railway and road bridge over the Ticino at Sesto-Calende (Italy)	March	170
<b>624 .9. Roofs.</b>		
Notes on certain fundamental principles governing the calculation of frameworks of structures and on the impressions to be gained in the course of reading the two Volumes I and II of <i>Vorlesungen über Statik der Baukonstruktionen</i> (Lectures on the Statics of Building Construction), of Prof. MAIER LEIBNITZ, by P. DUBUS	January	47
<b>625. RAILWAY AND ROAD ENGINEERING.</b>		
<b>625 .1. Railway engineering. Way and works.</b>		
The renewal of a retaining wall at Frankfurt South Station, by Karl Heinrich HANSEN	August	525
<b>625 .11. Scheme for a railway.</b>		
<b>625 .112. Gauge.</b>		
The standardization of railway gauges in Australia, by W.D. CHAPMAN	February	113
<b>625 .113. Longitudinal section. Gradients. Curves.</b>		
Recent knowledge on the layout of junctions on curves from the aspect of the curvature, by E. BÖSE	March	161
Accelerations on turnouts taken at high speeds. Considerations on their layouts, by J. CHAPPELLET	July	394

	Month.	Pages
<b>625 .14. Permanent way.</b> Special track design gives needed clearance in St. Clair tunnel . . . . .	January	29
<b>625 .142. Supports.</b>		
<b>625 .142. 4. Concrete sleepers.</b> The corrugated bush in concrete sleepers and the retention of tightness in the rail fastening. Position towards the end of the year 1951, by Br. NEUMANN . . . . .	March	150
<b>625 .143. Rails and their fastenings.</b>		
<b>625 .143 (0. General).</b> A locomotive rail-stress index, by C.W. CLARKE . . . . .	July	435
<b>625 .143 .3. Wear and breaking of rails.</b> New methods for testing rails by sounding, by M. PALMÉ . . . . .	January	43
Wear of rails on curves : a) running effects of locomotives and motor coaches with motor bogies, b) characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails, c) results of the investigations made and proposed remedies. Use of rail-lubrication processes. (Question 10, 16th Congress) : Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by V. VENKATARAMAYYA . . . . .	September	533
Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia), by L. RIPERT . . . . .	October	737
<b>625 .151. Turnouts (points, frogs, etc.).</b> Recent knowledge on the layout of junctions on curves from the aspect of the curvature, by E. BÖSE . . . . .	March	161
<b>625 .17. Permanent way. Maintenance and renewal.</b> What are the present tendencies relating to the organization of the maintenance of the permanent way : methods of determination of the works to be done and in particular, possibilities of the use of detecting-recording coaches; planning of the works, effects of mechanization; importance of the side-tracks for the movement of the gangs and the mechanical devices. Economic and financial aspect. (Question 1, 16th Congress) : Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by O. HJELTE CLAUSSEN . . . . .	August	471
Report (Belgium and Colony, France and French Union, Greece, Italy, Luxemburg, Netherlands, Portugal and Colonies, Switzerland, Syria and Turkey), by C. FEYRABEND . . . . .	December	993
<b>625 .173. Reconstruction and renewal.</b> Modern relaying in Germany . . . . .	March	158
<b>625 .19. Other questions.</b> The effects of soil movements due to the working of mines, by H. WIENECKE . . . . .	June	354

	Month.	Pages
<b>625 .21. Principal parts of the vehicle.</b>		
<b>625 .212. Axles. Wheels. Tyres.</b>		
Use of carbide tools for turning of wagon wheel sets . . . . .	May	277
Flaw-detection methods for railway axles, by N. NYSTRÖM . . . . .	»	287
Dynamic forces on railway wheel sets, by K.R. MELDAHL . . . . .	June	303
Trials of a coach on pneumatic tyres on the Paris Metropolitan Railway. Experiments on the shuttle service line « Porte des Lilas-Pré-Saint-Gervais », by Ulysse LAMALLE . . . . .	July	402
<b>625 .215. Bogies and Bissel bogies. etc.</b>		
Wear of rails on curves : a) running effects of locomotives and motor coaches with motor bogies, b) characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails, c) results of the investigations made and proposed remedies. Use of rail-lubrication processes. (Question 10, 16th Congress.) :		
Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by V. VENKATARAMAYYA . . . . .	September	533
Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia), by L. RIPERT . . . . .	October	737
<b>625 .22. Transverse section of vehicles and construction gauge.</b>		
Die Umgrenzung des lichten Raumes bei Regel- und Schmalspurbahnen ( <i>The loading gauge on standard and narrow gauge railways</i> ), by L. HECHLER ( <i>New Book</i> ) . . . . .	March	184
<b>625 .25. Brakes.</b>		
<b>625 .25 (02. General treatises.</b>		
Cours d'Exploitation des Chemins de fer. Tome IV : Traction à vapeur, Traction électrique, Traction Diesel, Freinage ( <i>Railway Operating Course. Volume IV : Steam Traction, Electric Traction, Diesel Traction, Brakes</i> ). Second edition, by U. LAMALLE ( <i>New Book</i> ) . . . . .	October	829
<b>625 .251. General.</b>		
Confines of braking, by H.R. BROADBENT . . . . .	February	99
<b>625 .28. Traction rolling stock.</b>		
Motive power for railways, by C.M. COCK . . . . .	September	655
<b>625 .28 (02. General treatises.</b>		
Cours d'Exploitation des Chemins de fer. Tome IV : Traction à vapeur, Traction électrique, Traction Diesel, Freinage ( <i>Railway Operating Course. Volume IV : Steam Traction, Electric Traction, Diesel Traction, Brakes</i> ). Second edition, by U. LAMALLE. <i>New Book</i> ) . . . . .	October	829
<b>625 .42. Underground railways.</b>		
Trials of a coach on pneumatic tyres on the Paris Metropolitan Railway. Experiments on the shuttle service line « Porte des Lilas-Pré-Saint-Gervais », by U. LAMALLE . . . . .	July	402

## 656. TRANSPORT BY ROAD, RAIL, ETC.

Het Concentratie-Verschijnsel in het binnenlandse Vervoerwezen (*The phenomenon of concentration in inland transport*), by J.P.B. TISSOT VAN PATOT (New Book) . . .

	Month.	Pages
	January	63

### 656 .2. Carriage by railway. Railway working.

Organization of traffic departments, by W.J. KELLY . . . . .

March	129
"	133

Traffic control method on British Railways, by R.L.E. LAWRENCE . . . . .

### 656 .21. Station working.

Station working and equipment on British Railways, by E.K. WHITTINGHAM. . . . .

July	373
------	-----

### 656 .211 .7. Connections with water communication. Ferries and ferry boats.

Cross-channel services of British Railways, by A.L. PEPPER. . . . .

April	203
-------	-----

### 656 .212. Goods station arrangements.

#### 656 .212 .6. Lines for loading and unloading : cranes and other appliances for handling goods.

Station working and equipment on British Railways, by E.K. WHITTINGHAM. . . . .

July	373
------	-----

### 656 .22. Trains.

#### 656 .222. Running of trains.

##### 656 .222 .1. Speed and load.

Recent developments in train speed recording, by F.R. AXWORTHY . . . . .

January	37
---------	----

#### 656 .222 .5. Passenger services.

The passenger traffic considered from the economic point of view . . . . .

March	174
-------	-----

### 656 .223. Utilisation and division of rolling stock.

#### 656 .223 .2. Utilisation and division of goods stock.

Determination of the number of wagons and locomotives required for the goods traffic,  
by D.S. ZIVKOVIC . . . . .

June	330
------	-----

### 656 .225 Goods services. Grouping.

Collapsible containers. . . . .

March	176
-------	-----

Freight traffic on British Railways, by H.R. BARRETT . . . . .

August	443
--------	-----

### 656 .254. Apparatus for communicating information at long distances, etc.

Trains run in either direction on both tracks, with new ACL installation of C.T.C. . . . .

February	121
----------	-----

Radiophonic communications in railway working. (Question 5, 16th Congress.) :

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by S.G. HEARN and J.H. FRASER . . . . .

September	615
October	709

**656 .257. Combined working of signals and points.**

*A.* Remote operating of signal boxes : technical realizations, working orders. *B.* Electric working and control devices for hinged and «flexible» points and switches. Control of accidental trailing of the switch blade. (Question 6, 16th Congress)

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by R. S. RVIK . . . . .

August 495

Report (Belgium and Colony, France and French Union, Greece, Italy, Luxemburg, Netherlands, Portugal and Colonies, Spain, Switzerland, Syria and Turkey), by J. NOGUÉS

October 801

Report (Austria, Bulgaria, Czechoslovakia, Germany, Hungary, Poland, Rumania and Yugoslavia), by A. DOBMAIER

November 923

**656 .26. Accessory services.****656 .261. Collection and delivery.**

Collapsible containers. . . . .

March 176

Freight traffic on British Railways, by H.R. BARRETT . . . . .

August 443

**656 .28. Accidents.**

Report to the Minister of Transport upon the Accidents which occurred on the Railways of Great Britain during the year 1951, by Lt. Col. G.R.S. WILSON (*New Publication*)

February 125

**656 .281. Derailments.**

The question of derailments, by P. KERFSZTY

January 1

**72. ARCHITECTURE.****721. ARCHITECTURAL CONSTRUCTION.**

Notes on certain fundamental principles governing the calculation of frameworks of structures and on the impressions to be gained in the course of reading the two Volumes I & II of *Vorlesungen über Statik der Baukonstruktionen* (Lectures on the Statics of Building Construction), of Prof. MAIFR LEIBNITZ, by P. DUBUS

" 47

**725. PUBLIC BUILDINGS.****725 .3 Transportation and storage.**

Modernisation of station buildings and methods employed in financing modernization projects. Standardisation of unit construction applied to railway building. (Question 2, 16th Congress.) :

Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible), by F.F.C. CURTIS

November 831

Report (Austria, Belgium and Colony, Bulgaria, Czechoslovakia, France and French Union, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Portugal and Colonies, Rumania, Spain, Switzerland, Syria, Turkey and Yugoslavia), by JOSE CHEDAS BOGARIM . . . . .

December 935

**CONTENTS**  
OF THE  
**30th YEAR OF THE ENGLISH EDITION.**

	Pages.	Numbers of the decimal classification.
<b>No. 1. — JANUARY 1953.</b>		
I. The question of derailments, by P. KERESZTY . . . . .	1	656 .281
II. Special track design gives needed clearance in St. Clair tunnel . . . . .	29	625 .14 (71)
III. Recent developments in train speed recording, by F.R. AXWORTHY . . . . .	37	656 .222 .1
IV. New methods for testing rails by sounding, by M. PALMÉ . . . . .	43	625 .143 .3 (44)
V. Notes on certain fundamental principles governing the calculation of frameworks of structures and on the impressions to be gained in the course of reading the two Volumes I and II of <i>Vorlesungen über Statik der Baukonstruktionen</i> (Lectures on the Statics of Building Construction), of Prof. MAIER LEIBNITZ, by P. DUBUS . . . . .	47	624 .9 & 721
VI. OFFICIAL INFORMATION ISSUED BY THE PERMANENT COMMISSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION : List of questions for discussion at the XVIth Session (London, 1954), with the names of the Reporters . . . . .	53	385 .06 .111
VII. NEW BOOKS AND PUBLICATIONS : The administration of the Cameroun Railways. Review by the Management.—Year 1951 . . . . .	60	385 .113 (66)
Chemins de fer 1952. <i>The Railways 1952</i> . A special supplement published by « Science et Vie » . . . . .	61	385 .09 (44)
La locomotive à vapeur ( <i>The steam locomotive</i> ), by André CHAPELON . . . . .	62	621 .13 (02)
Het Concentratie-Verschijnsel in het binnenlandse Vervoerwezen ( <i>The phenomenon of concentration in inland transport</i> ), by J.P.B. TISSOT VAN PATOT . . . . .	63	656 (492)
Was weisst Du von den Bundesbahnen? ( <i>What do you know about the Federal Railways</i> ), by Dr. F. KARNER. . . . .	64	385 .09 (436)
VIII. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	1	016 .385 (02)
<b>No. 2. — FEBRUARY 1953.</b>		
I. Individual axle drive. — Mechanical systems used on electric locomotives and motor coaches, with an indication of the results obtained in service on railways of all kinds ( <i>to be continued</i> ), by Adolphe-M. HUG . . . . .	65	621 .337
II. Confines of braking, by H.R. BROADBENT . . . . .	99	625 .251
III. The standardization of railway gauges in Australia, by W.D. CHAPMAN . . . . .	113	625 .112 (94)
IV. Trains run in either direction on both tracks, with new ACL installation of C.T.C. . . . .	121	656 .254 (73)
V. NEW BOOKS AND PUBLICATIONS : Report to the Minister of Transport upon the Accidents which occurred on the Railways of Great Britain during the year 1951, by Lt. Col. G.R.S. WILSON . . . . .	125	656 .28
Archiv für Eisenbahntechnik ( <i>Railway technical archives</i> ) . . . . .	126	385 (05 (43))
VI. German Transport Exhibition (Munich, 1953) . . . . .	127	...
VII. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	11	016 .385 (02)

No. 3. — MARCH 1953.

	Pages.	Numbers of the decimal classification
I. Organization of traffic departments, by W.J. KELLY . . . . .	129	656 .2
II. Traffic control method on British Railways, by R.L.E. LAWRENCE . . . . .	133	656 .2 (42)
III. The Central Staff Records Office of the S.N.C.F., by R. PARÈS and A. RENAULT . . . . .	137	385 .57 (44)
IV. The corrugated bush in concrete sleepers and the retention of tightness in the rail fastening. Position towards the end of the year 1951, by Br. NEUMANN . . . . .	150	625 .142 .4
V. Modern relaying in Germany . . . . .	158	625 .173 (43)
VI. Recent knowledge on the layout of junctions on curves from the aspect of the curvature, by E. BÖSE . . . . .	161	625 .113 & 625 .151
VII. A new type of bridge superstructure . . . . .	167	624 (73)
VIII. The new railway and road bridge over the Ticino at Sesto-Calende (Italy) . . . . .	170	624 .32 (45)
IX. The passenger traffic considered from the economic point of view . . . . .	174	656 .222 .5 (43)
X. Collapsible containers . . . . .	176	656 .225 & 656 .261
XI. OBITUARY : Rafael BENJUMEA BURÍN . . . . .	179	385 .09 .2
 XII. NEW BOOKS AND PUBLICATIONS :		
Malayan Railway Administration Report for the year 1951, by J.O. SANDERS . . . . .	181	385 .08 (59)
Facts and Figures about British Railways . . . . .	182	385 .42
Red Nacional de los Ferrocarriles Españoles. — Memoria del Consejo de Administración. Ejercicio 1951 (Spanish National Railways. — Report of the Administrative Council for the year 1951) . . . . .	182	385 (08 (460)
Convegno sulla Difesa del Suolo e le Sistemazioni fluviali e montane (Congress of Soil Conservation and the Management of water courses and mountains) . . . . .	183	55
Die Umgrenzung des lichten Raumes bei Regel- und Schmalspurbahnen (The loading gauge on standard and narrow gauge railways), by L. HECHLER . . . . .	184	625 .22
XIII. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	19	016 .385 (02)

No. 4. — APRIL 1953.

I. History and methods of Government regulation of Railway safety in Great Britain, by Brig. C.A. LANGLEY . . . . .	185	385 .3 (42)
II. Cross-channel services of British Railways, by A.L. PEPPER . . . . .	203	656 .211 .7 (42)
III. A new railway bridge constructed in welded steel, by M. FREI . . . . .	227	621 .392 (494) & 624 (494)
IV. OFFICIAL INFORMATION ISSUED BY THE PERMANENT COMMISSION OF THE INTERNATIONAL RAILWAY CONGRESS ASSOCIATION. — Meeting held by the Permanent Commission in Brussels, on the 17th January 1953. Appendix : List of Members of the Permanent Commission (17th January 1953) . . . . .	237	385 .06 .111
V. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	27	016 .385 (02)

	Pages.	Numbers of the decimal classification.
<b>No. 5. — MAY 1953.</b>		
I. Individual axle drive. — Mechanical systems used on electric locomotives and motor coaches, with an indication of the results obtained in service on railways of all kinds ( <i>to be continued</i> ), by Adolphe-M. HUG . . . . .	245	<b>621</b> .337
II. Use of carbide tools for turning of wagon wheel sets, by J. OLSON . . . . .	277	<b>621</b> .9 (485) & <b>625</b> .212 (485)
III. Flaw-detection methods for railway axles, by N. NYSTRÖM . . . . .	287	<b>625</b> .212 (485)
IV. What the Union Pacific gas turbines have been doing . . . . .	296	<b>621</b> .438 (73)
V. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	35	<b>016</b> .385 (02)
 <b>No. 6. — JUNE 1953.</b> 		
I. Dynamic forces on railway wheel sets, by K.R. MELDAHL . . . . .	303	<b>625</b> .212 (485)
II. Determination of the number of wagons and locomotives required for the goods traffic, by D.S. ZIVKOVIC . . . . .	330	<b>656</b> .223 .2
III. The effects of soil movements due to the working of mines, by H. WIENECKE . . . . .	354	<b>625</b> .19 (43)
IV. OBITUARY : AUGUSTE MARGUERAT . . . . .	370	<b>385</b> .(09) .2
V. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	43	<b>016</b> .385 (02)
 <b>No. 7. — JULY 1953.</b> 		
I. Station working and equipment on British Railways, by E.K. WHITTINGHAM . . . . .	373	<b>656</b> .21 (42) & <b>656</b> .212 .6 (42)
II. Accelerations on turnouts taken at high speeds. Considerations on their layouts, by J. CHAPPELET . . . . .	394	<b>625</b> .113
III. Trials of a coach on pneumatic tyres on the Paris Metropolitan Railway. Experiments on the shuttle service line « Porte des Lilas-Pré-Saint-Gervais », by Ulysse LAMALLE . . . . .	402	<b>625</b> .212 (44) & <b>625</b> .42 (44)
IV. Central Railway Centenary Celebrations in Bombay, 16th April, 1953 . . . . .	414	<b>385</b> .(09) (54)
V. Indian Railways, 1853-1953, by F.C. BADHWAR . . . . .	417	<b>385</b> .(09) (54)
VI. A locomotive rail-stress index, by C.W. CLARKE . . . . .	435	<b>625</b> .143 (0)
VII. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	51	<b>016</b> .385 (02)

	Pages.	Numbers of the decimal classification
No. 8. — AUGUST 1953.		
I. Freight traffic on British Railways, by H.R. BARRETT . . . . .	443	656 .225 (42) & 656 .261 (42)
II. What are the present tendencies relating to the organization of the maintenance of the permanent way : methods of determination of the works to be done and in particular, possibilities of the use of detecting-recording coaches; planning of the works, effects of mechanization; importance of the side-tracks for the movement of the gangs and the mechanical devices. Economic and financial aspect. (Question 1, 16th Congress) Report ( <i>America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible</i> ), by O. Hjelte CLAUSSEN . . . . .	471	625 .17
III. a) Remote operating of signal boxes : technical realizations, working orders. b) Electric working and control devices for hinged and « flexible » points and switches. Control of accidental tripping of the switch blade. (Question 6, 16th Congress) Report ( <i>America (North and South), Australia (Commonwealth of), Burma, Ceylon, China, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible</i> ), by R. SØRVIK. . . . .	495	656 .257
IV. Dieselisation of the West Clare Railway, by J.J. JOHNSTON . . . . .	519	621 .431 .72 (41)
V. The renewal of a retaining wall at Francfort South Station, by Karl Heinrich HANSEN .	525	625 .1 (43)
VI. NEW BOOKS AND PUBLICATIONS : World Railways 1952-1953. . . . . Schweizerische Verkehrsstatistik, 1951 ( <i>Swiss transport statistics, 1951</i> ) . . . . .	530 531	385 (09 (3) 313 .656 (494)
VII. MISCELLANEOUS : Award of the Gold Medal of the Institution of Locomotive Engineers . . . . . Results of the competition for new designs of track brakes held by the German Ministry of Transport . . . . .	532 532	
VIII. MONTHLY BIBLIOGRAPHY OF RAILWAYS . . . . .	59	016 .385 (02)
No. 9. — SEPTEMBER 1953.		
I. Wear of rails on curves : a) running effects of locomotives and motor coaches with motor bogies, b) characteristics of track-laying on curve and details of the rolling stock liable to cause premature wear of the rails, c) results of the investigations made and proposed remedies. Use of rail-lubrication processes. (Question 10, 16th Congress.) Report ( <i>America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible</i> ), by V. VENKATARAMAYYA . . . . .	533	621 .135 .4, 625 .143 .3 & 625 .215

Pages,	Numbers of the decimal classification.

No. 9. — SEPTEMBER 1953 (*continued*).

II.	Determination of the principles of geographical and functional organization of a railway system. Simplification and retrenchment of the administration of railways. (Question 8, 16th Congress.) Report ( <i>America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible</i> ), by Bengt ADAMSON . . . . .	573	385 .4
III.	Radiophonic communications in railway working. (Question 5, 16th Congress.) (Report ( <i>America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible</i> ) ( <i>to be continued</i> ), by S.G. HEARN and J.H. FRASER . . . . .	615	656 .254
IV.	<b>NEW BOOKS AND PUBLICATIONS</b> <b>Activité et productivité de la S.N.C.F. en 1952</b> ( <i>The activities and productivity of the S.N.C.F. in 1952</i> ) . . . . .	655	385 .113 (44)
	Motive power for railways, by C.M. COCK . . . . .	655	625 .28
	Henschel-Lokomotiv Taschenbuch ( <i>Henschel pocket locomotive book</i> ) . . . . .	656	621 .13 (02)

No. 10. — OCTOBER 1953.

I.	Technical and economic investigation of the basic characteristics of electric traction systems now in use, with a view to decide whether, and to what extent, there are relevant reasons for preferring one system to another. In particular are there any reasons in regard to : a) power supply, b) overhead line and fixed track installations, c) motive power units, d) working and maintenance costs. (Question 3, 16th Congress.) Report ( <i>America (North and South), Australia (Commonwealth of), Burma, Ceylon, Denmark, Egypt, Finland, India, Indonesia, Irak, Iran, Republic of Ireland, New Zealand, Norway, Pakistan, South Africa, Sweden and the United Kingdom of Great Britain and Northern Ireland and the territories for whose international relations the United Kingdom is responsible</i> ), by S.B. WARDER . . . . .	657	621 .33
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III.	Determination of the principles of geographical and functional organization of a railway system. Simplification and retrenchment of the administration of railways. (Question 8, 16th Congress.) Supplement to Report, by Bengt ADAMSON . . . . .	729	385 .4

Pages.	Numbers of the decimal classification
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No. 10. — OCTOBER 1953 (*continued*).

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- VI. OBITUARY : Gustaf DAHLBECK . . . . . 827 385 .(09) .2
- VII. NEW BOOKS AND PUBLICATIONS :  
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No. 11. — NOVEMBER 1953 (*continued*).

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Pages. | Numbers  
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923 | 656 .257

V. NEW BOOKS AND PUBLICATIONS :

- Directory of Railway Officials & Year Book, 1953-1954 . . . . . 934 | 385 .02

No. 12. — DECEMBER 1953.

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935 | 725 .3

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949 | 385 .4

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985 | 385 .57

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993 | 625 .17

- V. ANALYTICAL TABLE OF ARTICLES ACCORDING TO THE DECIMAL CLASSIFICATION . . . . .

1 to 8 . . . . .

- VI. CONTENTS OF THE 30TH YEAR OF THE ENGLISH EDITION . . . . .

I to VII . . . . .

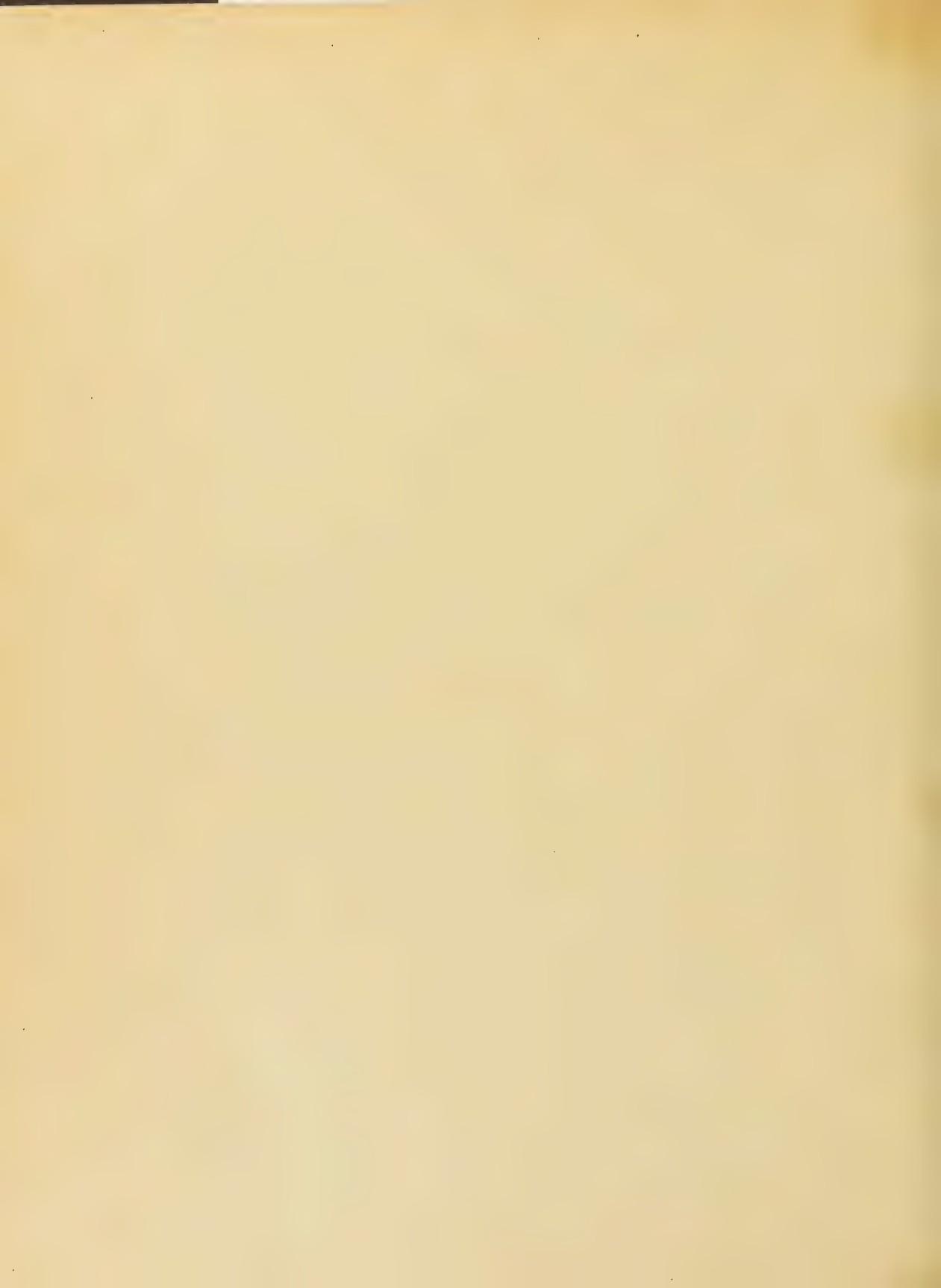


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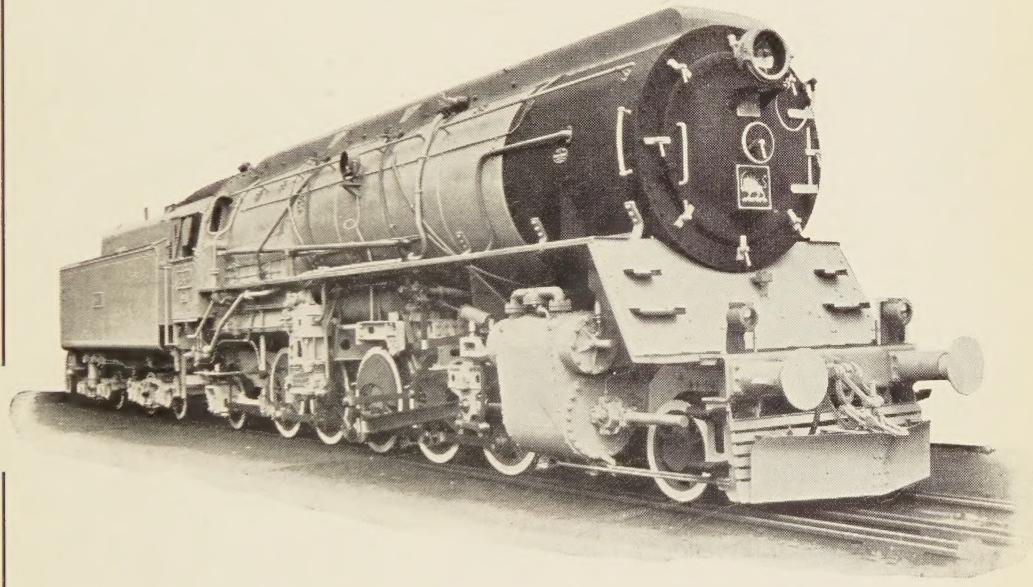
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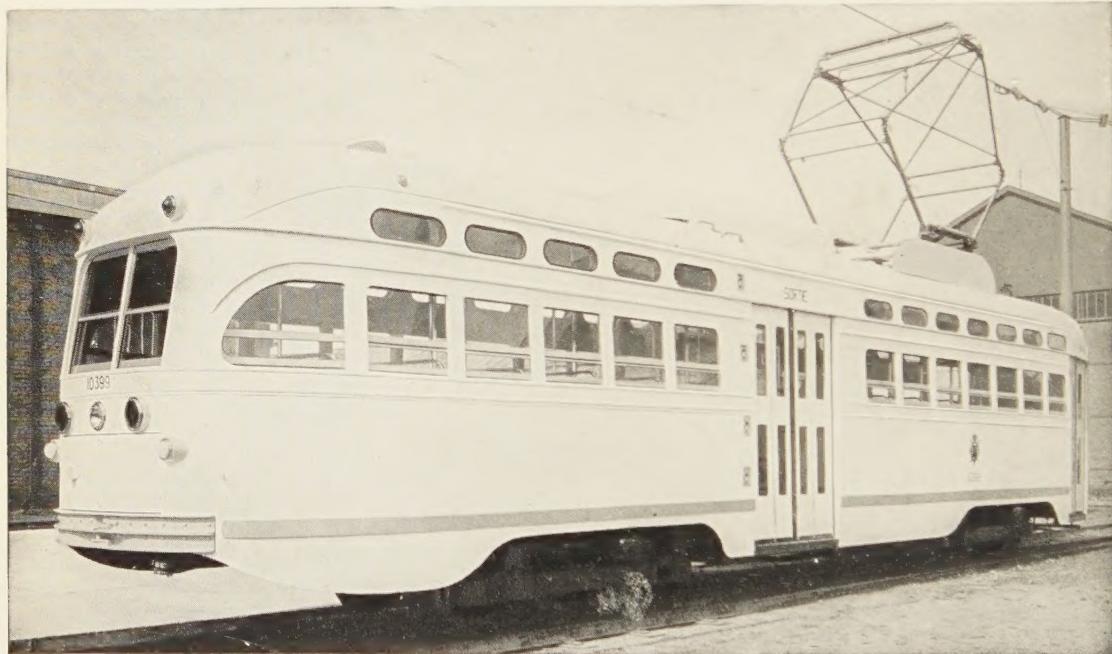
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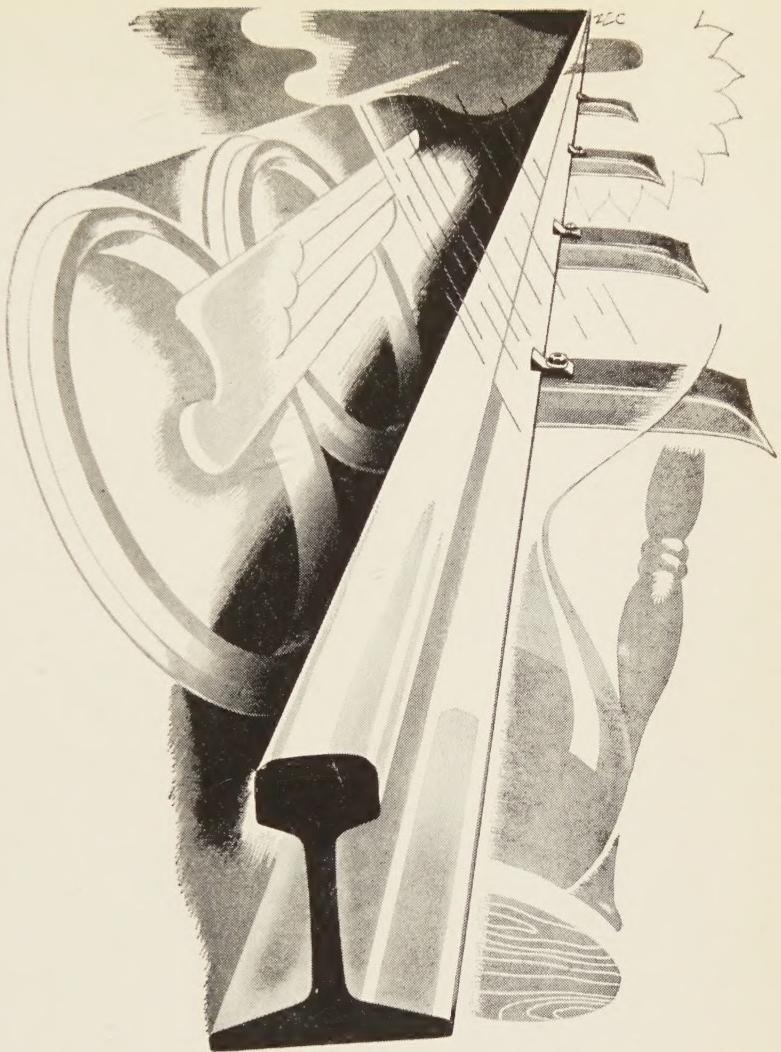


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